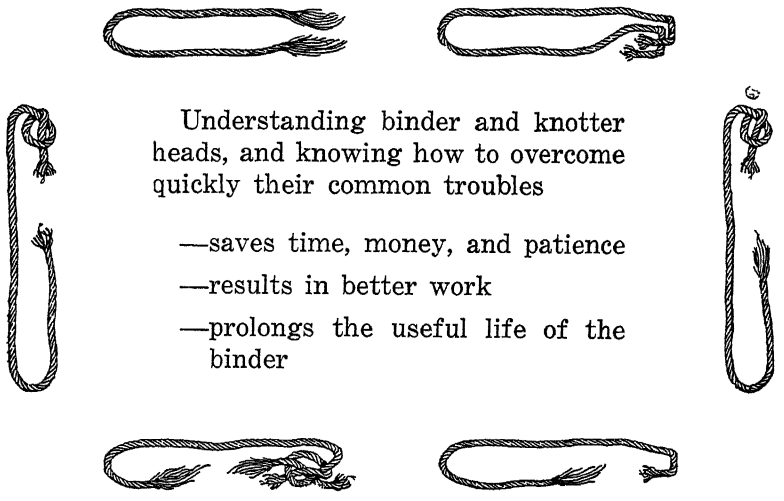
87 BULLETIN Reprinted June, 1942
OF THE
AGRICULTURAL EXTENSION SERVICE, THE OHIO STATE UNIVERSITY

Common Binder Head and Knotter Head Troubles



Understanding binder and knotter heads, and knowing how to overcome quickly their common troubles

—saves time, money, and patience

—results in better work

—prolongs the useful life of the binder

OHIO STATE UNIVERSITY AND THE UNITED STATES DEPARTMENT OF AGRICULTURE, COOPERATING
AGRICULTURAL EXTENSION SERVICE, H. C. RAMSOWER, *Director*, Columbus.
Printed and distributed in furtherance of Acts of May 8 and June 30, 1914

ACKNOWLEDGMENT

The material herein is a revision, with additions, of the original presentation by C. O. Reed which appeared first in *Farm Implement News*, June 3, 1915.

Special Instructions

•

☞KEEP THIS BULLETIN in the tool box of the binder for ready reference during the harvest season. Although it covers grain binders primarily and shows grain binder illustrations only, nevertheless it includes many of the adjustments and troubles common with corn binders.

ARRANGEMENT. The coarser print is for the operator who wants results quickly without stopping to determine the principles of the adjustment. The finer print gives principles of operation, function of parts, explanation of causes and remedies; it is for the man who wants to know "why," or for one who has a type of binder not specifically illustrated herein.

HOW TO PROCEED. Care for the binder, oil it, keep it in good repair and adjustment. But do not tamper with it by the "hit and miss" method. When you are sure that trouble exists, proceed systematically and intelligently. Find your trouble listed herein. Take a moment to read the directions carefully; look at the right picture to make sure of the exact part to adjust on your particular machine. If your machine is not illustrated herein, or if you have an old type machine or an unusual trouble, read also the finer print to get principles of operation in mind. Then you will be able to locate the proper parts to adjust on your machine, and the remedies for unusual troubles will be more obvious.

WARNING ABOUT NEW HEADS. Never adjust or tamper with a new binder head or new knotter head. It was tested and set before it left the factory. It may be a little stiff; it may be stuck with paint. A new knotter head may miss the first few bundles. But do not tamper with it—kerosene it well, then oil it, keep working it—it will function perfectly within a short time.

WARNING ABOUT ADJUSTMENTS. Make all spring adjustments and other similar changes gradually until you reach the proper set. A quarter of a turn at a time on spring stud bolts is enough. Be patient, or you may pass the point of proper set. Then another trouble may result because you have made a too radical change. This is what confuses so many operators.

Contents

Binder Heads

(The binder head is the entire head assembly suggested by illustrations on pages 6 to 8)

Prepared by
C. O. REED* AND R. D. BARDEN
Department of Agricultural Engineering, The Ohio State University

Trouble 1. Bundles Too Large or Too Small.

Refer to illustrations on pages 6, 7, and 8. On McCormick, Deering, Deere, and Osborne heads, to make bundle smaller, move compressor arm in or nearer packers; to make bundle larger, move compressor arm out or farther from packers.

On Massey-Harris head, Fig. 6, to make bundle smaller, move compressor arm in or nearer packers and set trip arm higher. To make bundles larger, move compressor arm out or farther from packers and set trip arm lower. Raising or lowering the trip arm is accomplished by the slot adjustment under the trip arm.

The binder head on the Deere tractor binder, not shown herewith, carries a trip arm which is independent of the compressor arm. To make bundles smaller, move compressor arm in or nearer packers and set trip arm higher. To make bundles larger, move compressor arm out or farther from packers and set trip arm lower. Raising or lowering this trip arm on the Deere power head is accomplished by turning the trip block on the trip shaft. This trip block is under the stop arm.

In binder heads which carry a trip arm separate from the compressor arm, changing the size of bundle may also affect the tightness of the bundle, as described below. Get size desired first; then adjust for tightness as described under Trouble 2 on page 9.

Explanation. The size of the bundle of grain depends primarily upon how large the space is in which the bundle forms. All binder heads carry a *compressor arm* which is the arm, standing almost vertically, that prevents the grain from slipping off the deck while the bundle is forming. It is the arm against which the packers pack the straw, and against which the needle compresses the bundle during the tying operation. Setting the compressor arm out or farther away from the packers creates a larger space in which to form the bundle; hence a larger bundle results. Setting the compressor arm nearer the packers makes a smaller bundle.

Massey-Harris, Osborne, Champion, Milwaukee, Moline and Adriance binder heads, and the binder heads on Deere tractor binders, carry a trip arm in addition to and independent of the compressor arm; it lies nearly horizontal, instead of standing vertical, as indicated in Figs. 5 and 6 on Page 8. In some of these heads the trip arm can be set higher or lower. When adjustable, the trip arm can be used to affect size of bundle, in addition to the usual compressor arm changes. Setting the independent trip

*Deceased.

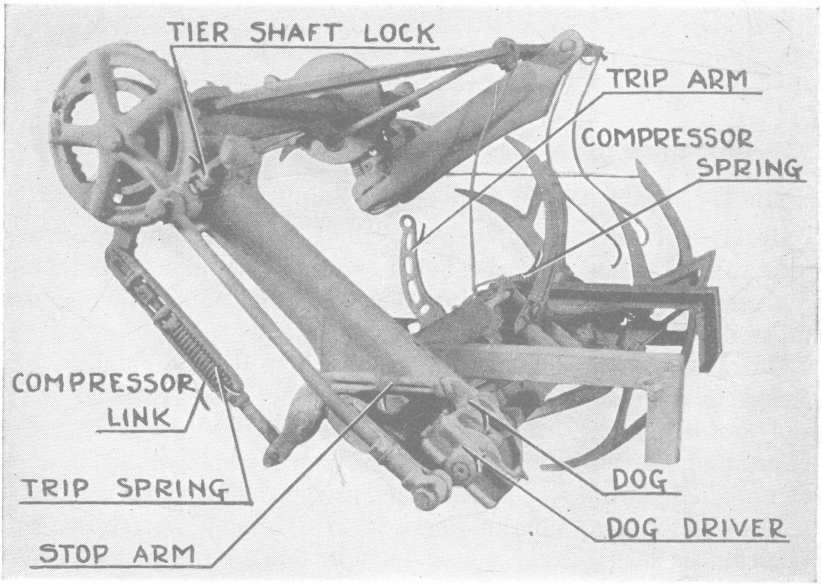


Fig. 1. McCormick Binder Head. Now Known as the I. H. C. Model M.

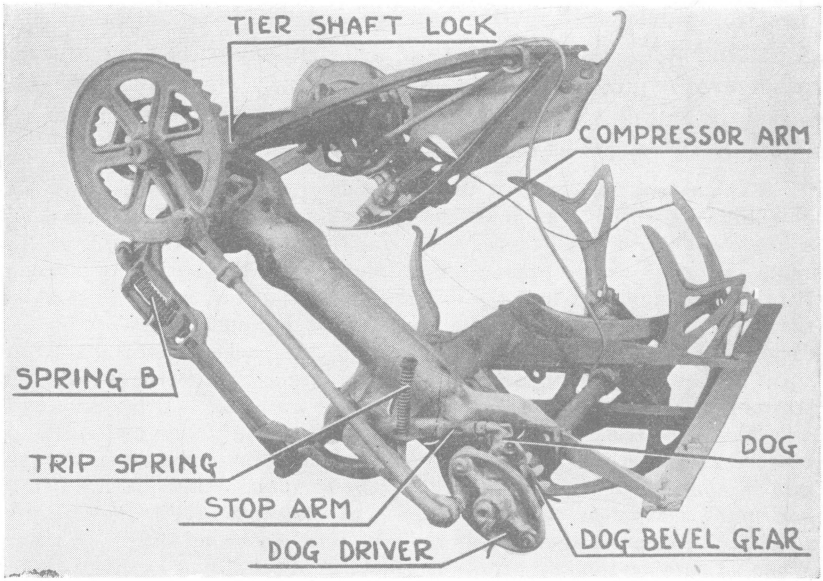


Fig. 2. Deering Binder Head. Now Known as the I. H. C. Model D.

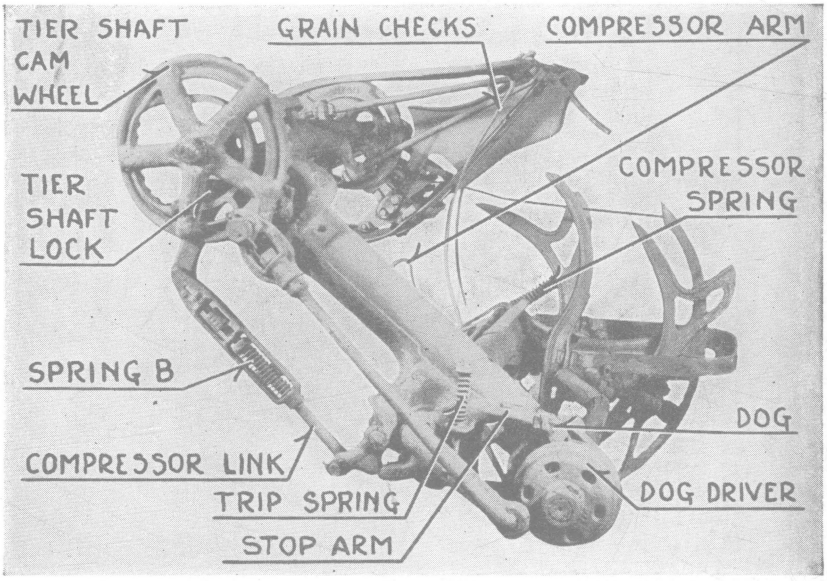


Fig. 3. Deere Binder Head of Type With Adjustable Stop Arm.

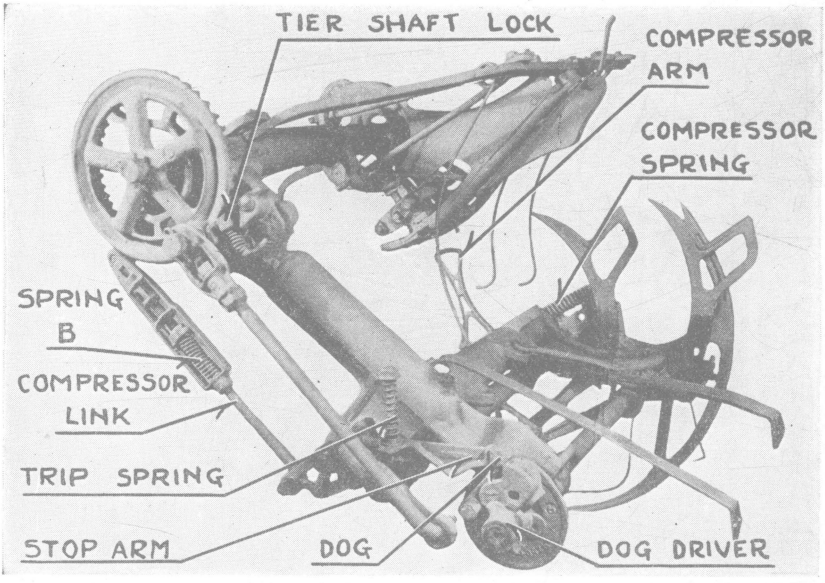


Fig. 4. Deere Binder Head of Type With Adjustable Tier Shaft Lock.

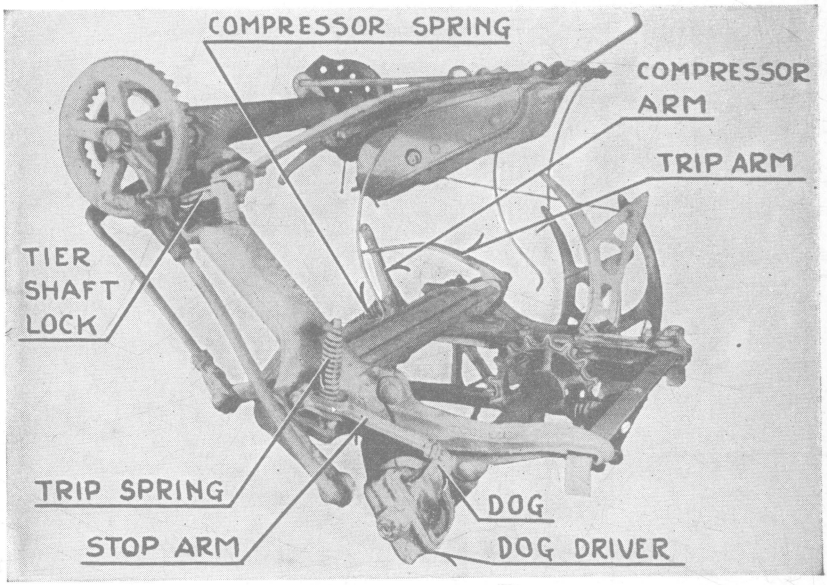


Fig. 5. Case-Osborne Binder Head.
Formerly Known as the E-B Osborne, or the Osborne.

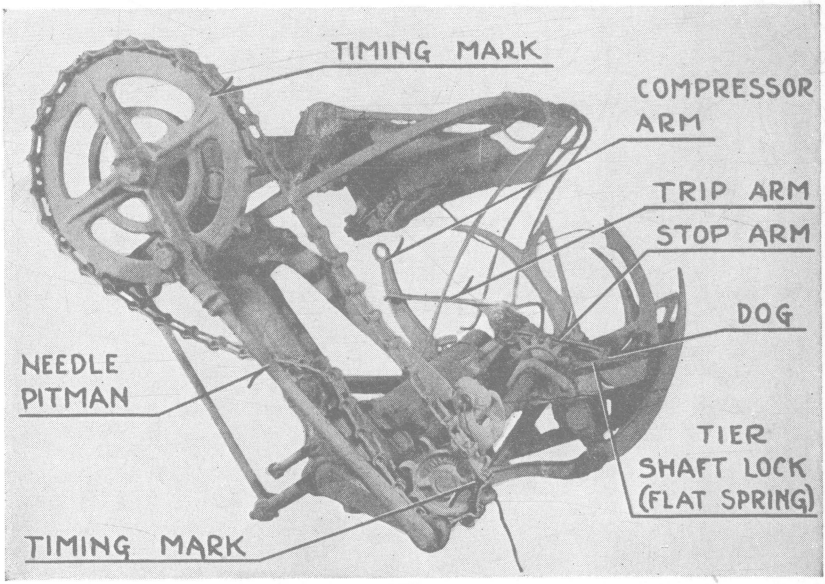


Fig. 6. Massey-Harris Binder Head.

arm higher decreases the bundle space and causes a small bundle; setting it lower increases the size of bundle. Setting the trip arm, however, also affects tightness of bundle as described under Trouble 2 on page 9.

Tightness of bundle depends upon how much straw is packed into any size of bundle as described under Trouble 2. For all practical purposes size and tightness should be considered independently of one another. Get the desired size by the adjustments suggested under this Trouble 1; if that adjustment changes the tightness, then adjust for tightness as suggested below under Trouble 2.

Trouble 2. Bundles Too Tight or Too Loose.

Refer to illustrations on pages 6, 7, and 8; be sure to identify the correct spring as the trip spring. On all heads, to make bundles looser, loosen trip spring; to make bundles tighter, tighten trip spring. Do not attempt to make bundles tighter by tightening the twine tension. See Warning About Twine Tension, page 22. On the McCormick head be careful, when adjusting trip spring, not to molest the six-sided nut toward the top of the compressor link.

Explanation. The packer shaft, which carries the packers, revolves continuously; thus the packers continually attempt to pack grain into the bundle chamber. All other parts of the binder head are at rest while the bundle is forming. When the bundle is ready to be tied and cast, motion to perform these operations is secured from the packer shaft through a clutch known as the *dog*. The packer shaft carries a *dog driver* close to the dog. When the dog is released, its spring causes it to jump into such position that a lug or *tail* on the dog is caught by the dog driver on the packer shaft; thus the dog is forced to revolve with the packer shaft as long as this clutch mechanism is engaged. While the dog is being driven by the packer shaft, it in turn drives the discharge arms and needle through various gears, shafts or chain which one can locate readily if he will trace the power from the dog to the *tier shaft* (shaft which carries discharge arms).

By the time the discharge arms have revolved once, the dog has revolved usually three times. Inasmuch as the discharge arms must now come to rest while the next bundle is forming, the dog or clutch must be disengaged to break the motion between the packer shaft and other binder head parts. Hence, at the proper moment, a stop arm moves into the path of the dog, and, when the latter reaches its position of rest, the stop arm forces the dog back against its spring in such position that the dog's lug or tail is no longer in the path of the dog driver. The dog then remains at rest until released again when the next bundle is ready to be tied and cast.

What releases the dog? Under the discharge arms there is a *trip arm* against which the straw is exerting more and more pressure as the bundle forms. (In the McCormick, Deering, and Deere binder heads, the compressor arm and trip arm is the same casting; it acts as a trip arm up to the moment the head is tripped; after that the casting functions as a compressor arm. In Osborne, Massey-Harris, Champion, Milwaukee, Moline, and Adriance binder heads and in the binder heads of Deere tractor binders. the compressor arm and trip arm are separate, the latter lying more nearly parallel to the deck).

The trip arm is connected with the stop arm through a shaft, so that the stop arm is raised when the trip arm is forced outward or downward by the pressure of the straw. The stop arm, however, cannot be raised to release the dog until force enough is brought to bear on it to overcome the tension in a spring which constantly tries to hold the stop arm down. This spring, found in all heads, is the *trip spring*. Usually it is just above or just below the stop arm and works directly on the arm, although in some heads, like the McCormick, the trip spring may be some little distance from the stop arm.

Tightening the trip spring makes necessary a greater pressure from the straw before the head is tripped; this requires more straw in the bundle to give the necessary pressure, hence a tighter bundle results. Loosening the trip spring requires less straw in the bundle to accomplish the tripping action, hence a looser bundle results.

In the Deering head, Fig. 2, page 6, spring B is not a trip spring; do not molest or adjust it unless it has been tampered with. It simply allows the compressor link to lengthen to enable the tier shaft lock to drop home; it also snaps the lock into place quickly. In Deere binder heads, as shown in Figs. 3 and 4, page 7, first use trip spring to regulate tightness; ordinarily it will give as large range of adjustment as is needed. If more range is needed, spring B can be used; but never have spring B so tight that the cam roller, in the tier shaft cam wheel just above, cannot reach its position of rest. If, in extreme cases, you adjust spring B, do not molest the six-sided nut toward the top of the compressor link.

In binder heads which carry a separate trip arm in addition to a compressor arm, the operator may find that the bundles are looser after he sets the compressor arm outward to secure a larger bundle (see under Trouble 1). This occurs because the bundle, in forming farther out on the trip arm, has greater leverage to raise the stop arm. Likewise, moving the compressor arm in to secure a smaller bundle may result also in a tighter bundle. In some heads raising and lowering the trip arm also affects tightness to some degree, because the leverage of the bundle on the stop arm may be increased or decreased. Such complexities may be avoided, however, and the adjustments greatly simplified, if the operator will consider size and tightness separately. Set the size you want by the adjustments given under Trouble 1; then get the desired tightness by the adjustments suggested under this Trouble 2.

Trouble 3. Discharge Arms Fail to Start, or Revolve Part Way and Stop.

Find dog in illustrations on pages 6, 7, and 8. Dog spring (spring which causes dog to jump forward, or into path of dog driver, when stop arm rises) is lost, weak, or broken. If weak, try stretching. If lost or broken, supply new one. Do not confuse this trouble with Troubles 15, 16, and 17.

Explanation. When the stop arm rises and releases the dog (see explanation under Trouble 2), the dog jumps forward due to the action of the *dog spring* which continually tries to keep the dog in position to be

caught and driven by the dog driver. If the dog spring has become too weak to force the dog forward, or if it is broken or lost, the dog may not become engaged when released by the stop arm and the discharge arms will fail to start. On some heads the dog will drop forward due to its own weight, even when the dog spring is absent. If the pressure of the dog driver on the dog remains fairly constant, the discharge arms may then complete their revolution. But if this pressure is relieved for an instant, as sometimes happens when cutting on rough ground, the dog may drop away from the dog driver when it has made three-quarters of a revolution; then, when the machine picks up speed again, the discharge arms will remain at rest because the dog has become disengaged. A weak dog spring may be helped temporarily by stretching or bending slightly.

While the bundle is being tied in some old binder heads, the stop arm is held away from the dog by the weight of the bundle instead of by the positive mechanism found in modern heads. In these old heads this Trouble 3 is caused also by striking faces between the dog and stop arm having become worn beveled shaped as described under Trouble 9 on page 14. The slanting faces may let the dog raise the stop arm and slip by it once, but on the next revolution the stop arm may succeed in stopping the dog. For remedy see under Trouble 9.

Trouble 4. Discharge Arms Revolve With Jerky Motion.

Instead of revolving with smooth continuous action, the discharge arms revolve part way—then stop for an instant—then jerk ahead again. (Refer to illustrations on pages 6, 7, and 8.) Dog driver is slipping by the dog at moments of excessive pressure, because the striking faces between the dog driver and dog are badly worn. The trouble may be caused partly, too, by weakness in the dog spring. Supply new dog and dog driver; also new dog spring if the spring is weak. Strengthening the spring by stretching or bending it may help temporarily. But if the striking faces of the dog and dog driver are badly worn or battered these castings should be renewed.

Explanation. When the dog is released and jumps forward due to the action of its spring, a lug on the dog gets into the path of a lug on the dog driver; thus the dog driver, which is revolving continuously on the packer shaft, causes the dog casting to revolve as described under Trouble 2. These lugs should be so shaped and in such condition that one cannot slip by the other as long as the dog is released by the stop arm. The lugs (known as the striking faces between dog and dog driver) wear, and often, due to Troubles 10 and 11, get badly battered. If they get into such condition that the dog driver can force the dog back against its spring and thus slip past the dog at moments of excessive pressure, the dog will stop momentarily; then it will be picked up again by the next lug on the dog driver, then perhaps stop and start again.

This hit and skip process may continue during the entire three revolutions of the dog for each bundle. It is obvious that each time the dog

stops and starts the discharge arms do likewise; they revolve by stopping and starting with jerky motion instead of revolving with unbroken, smooth action. The only permanent remedy is supplying a new dog and dog driver, and remedying Troubles 10, 11, 12, 13, and 14 if they are found to exist.

Trouble 5. Discharge Arms Revolve Continuously.

Same as Trouble 6. Refer to pages 6, 7, and 8. Dog is badly "out of time" with stop arm. On McCormick, Deering, Deere, and Osborne binder heads remove dog driver. Move discharge arms (arms which force bundle out of head) around until they are in position of rest or "at home." (When the discharge arms are "home," the tier shaft lock will have dropped into place, securing the discharge arms so that they cannot be moved backward or "droop.") Now find the bevel gear which carries the dog. Slip this bevel gear out of mesh with the bevel gear which it drives. Holding the dog back fully compressed against its spring, as shown in Fig. 7, move the dog level gear around until the face of the dog touches the face of the stop arm. Then push the dog bevel gear into mesh with its mate so that the stop arm replaces your finger in holding the dog compressed against its spring. Then replace dog driver.

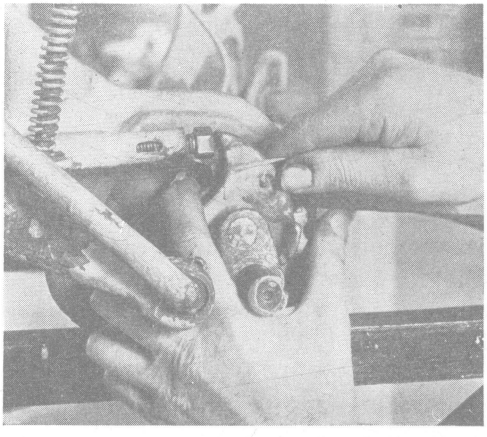


Fig. 7. Timing the Dog. See description under Trouble 5.

After this operation you should be able to pull the dog away from the stop arm until ⅛ inch clearance exists between the faces when the dog is fully compressed against its spring. If more clearance exists, clicking may result; lengthen stop arm or advance tier shaft lock until the proper clearance exists; see further under Trouble 10. If the stop arm and dog fit together too tightly, shorten stop arm or retard tier shaft lock slightly; see further under Troubles 10 and 11.

On the Massey-Harris head, remove sprocket chain which drives tier shaft. Set discharge arms in normal position of rest, or "at home," as shown in Fig. 6, page 8. Turn small sprocket around until stop arm has forced back dog, and tier shaft lock has dropped

into place. Replace sprocket chain, with fourteen links of chain between the arrow cast on the tier shaft sprocket and the timing mark cast in the small sprocket. Readjust chain tightener to prevent chain jumping and excessive lost motion, but not tight enough to cause binding and excessive wear.

Explanation. When the dog is ready to be disengaged from the dog driver, the stop arm should have returned to position to accomplish that act (see description under Trouble 2). Or, when the stop arm is ready to "throw the dog out," the dog should be far enough around in its revolution to be caught by the stop arm. This suggests that a very positive timing relation exists between the two if they are to function properly in relation to one another. If the dog is badly out of time, the stop arm may miss the dog entirely; then the discharge arms will revolve continuously and very small bundles will be cast. If the dog is slightly out of time, it will be disengaged by the stop arm before the tier shaft lock has dropped into place, or too long after the tier shaft lock has set, as described under Trouble 11 below.

The stop arm and dog are connected rather indirectly instead of directly, as one can easily determine if he will start at the dog and trace the power around through the head until he reaches the device which controls the return of the stop arm to its position of rest. The timing relation between dog and stop arm must be maintained at every connection throughout this power line. If one removes the dog gear, if he removes the tier shaft cam wheel, if he removes the chain that drives the tier shaft —and replaces any of these parts without paying attention to the timing relation—the dog is almost sure to be out of time with the stop arm. Do not adjust tier shaft lock or length of stop arm in an attempt to overcome difficulties caused by the dog's being out of time. Conversely, do not throw the dog out of time to make up for poor adjustment in tier shaft lock, or for stop arm being too long or too short. The distinction should be thoroughly understood. See descriptions under Troubles 7, 10, and 11.

Trouble 6. Very Small Bundles Continuously.

Same as Trouble 5 on page 12.

Trouble 7. Discharge Arms Locked Properly Yet Not in Normal Position of Rest, and Needle May be Advanced so Far That Grain Cannot Pass Down Deck.

On Massey-Harris this is because the dog is out of time with the tier shaft which carries the discharge arms. Retime as directed in Trouble 5 on page 12.

Trouble 8. A Small Bundle Occasionally in Tangled Grain or Where a Heavy Growth of Bushy Weeds Abounds.

The trouble is usually caused by a large bundle failing to clean away from the head; the butts of the cast bundle remain interwoven with the butts of the bundle just forming, and the weight of the

cast bundle again trips the head before the next bundle is fully formed. This is not necessarily a binder head trouble; most likely the difficulty lies in the condition of the grain. If no binder head trouble exists, adjust the platform, reel, and butter to form a better shaped bundle on the deck. Try tying bundle closer to butts of grain, by moving the binder head forward. Or try a smaller or looser bundle. Loosening grain checks often helps materially.

Trouble 9. A Small Bundle Occasionally in Good, Standing Grain.

Refer to illustrations on pages 6, 7, and 8. Dog slips by stop arm occasionally because the striking faces between the two have become worn beveled to such an angle that the dog can raise the stop arm instead of being halted by it. Supply new stop arm and dog. If it is desired to remedy this trouble without supplying new parts, proceed as follows: file the face of stop arm and of dog so that the faces of the two strike together more squarely instead of at a dangerous angle. After metal has been filed away, the dog will rest in a slightly advanced position; hence dog driver will tap dog as the former revolves. To eliminate this tapping see Trouble 10.

Explanation. The striking faces between the stop arm and dog (for function and operation of these parts see explanation under Trouble 2) are so designed that, when new, they strike squarely together or at such angle that the stop arm cannot be lifted by the dog when they come together. As the binder ages, these faces often become worn beveled by the friction between them caused by the discharge arm rising slowly and playing up and down slightly as the bundle fills. The upper half of the dog face and the lower half of the stop arm face wear most; finally such a slant develops that the dog has a tendency to lift the stop arm by slipping under it. Occasionally, then, when it happens to be revolving a little faster than normal, the dog hits the stop arm so hard that it raises the arm and begins another cycle of revolutions. Obviously, the discharge arms are forced to make a second revolution immediately, and a small bundle is cast.

On some old heads in which the stop arm is held out of the path of the dog by the pressure of the bundle, the dog may raise the stop arm due to the beveled condition of both faces. But, after the dog has completed one revolution, the stop arm may catch the dog because there is not enough grain in the bundle to hold the stop arm up. In this case no bundle will be cast, and the discharge arms will have advanced part of the way and stopped.

After the striking faces between the dog and stop arm have been filed square as suggested above, the dog spring will take advantage of the resulting clearance between the dog face and stop arm; it will cause the dog to rest in a position slightly advanced on its bearing. Then the dog driver (for function see explanation under Trouble 4) will tap the dog as the former revolves. This tapping or clicking is Trouble 10; see Trouble 10 on next page for further explanation and remedy.

Trouble 10. Tapping. Dog Driver Taps Dog.

There is a difference between tapping and pounding. If the dog driver pounds the dog seriously, and at the same time the discharge arms shake, vibrate, or seem to chatter, see Trouble 11. If the dog driver simply taps or clicks the dog as the dog driver revolves, the tapping is probably because the dog is not held back far enough when in its position of rest. Lengthen stop arm slightly. If the stop arm is not adjustable in length, advance the tier shaft lock slightly. In either of these adjustments be sure to maintain the proper clearance between the striking faces of the stop arm and dog as described under Trouble 5, page 12.

In some old binder heads the tier shaft lock is simply a flat spring, the end of which seats behind a lug cast onto the tier shaft cam wheel. This spring can be advanced or retarded; but if the spring has become so short by wear that it can no longer be advanced far enough to overcome tapping, supply a new spring.

For further explanation, for the influence of backlash in gears, why this trouble develops gradually, see explanation below.

Explanation. If one will lift up on the discharge arms when they are in normal position of rest, he will find that he cannot raise them far because the dog is already against the stop arm. In other words, the discharge arms and dog are connected rather indirectly through a power train composed of various shafts, bevel or spur gears—perhaps a chain; and when you attempt to move the discharge arms in their normal direction of rotation you also attempt to move the dog and each other part of the power train in its normal direction of rotation. If you bear down on the discharge arms, which act attempts to back up the dog and all other parts of the power train, you will find that you cannot often force the arms downward because they are "locked up" by a *tier shaft lock.* This lock may be within the tier shaft cam wheel, as in Deerings and some Deeres; it may work on the outside of the tier shaft cam wheel, as in the McCormick, or it may be close to the dog under the deck as in the Massey-Harris.

The dog spring (see description under Trouble 3) of course is exerting a force at all times in two directions: while it is attempting to force the dog forward, also it is trying to force backward the entire power train extending to the discharge arms. The tier shaft lock, in preventing the discharge arms from backing up, thus prevents the power train from backing up. In further explanation, the stop arm and the tier shaft lock are the ultimate bases between which the dog spring is compressed. They must be set so that the dog spring is compressed enough to let the lug on the dog (see explanation under Trouble 2) rest out of the path of the dog driver; otherwise, the dog driver will tap or click the dog as the former revolves.

A moment's reflection now will reveal that clicking will result if metal has been filed away on the faces of the stop arm and dog, as described under Trouble 9; if the stop arm is too short; if the tier shaft lock is retarded too far; if the binder head is old, and a slowly developing wear has

resulted in excessive back-lash in the gears of the power train. None of these causes results in the dog actually being out of time as interpreted in Trouble 11.

All modern heads carry either an adjustable tier shaft lock or a stop arm which can be adjusted in length. To overcome typical tapping or clicking, lengthen the stop arm slightly, or advance the tier shaft lock slightly. In making these adjustments be sure to leave close to ⅛ inch clearance between the striking faces of the stop arm and dog. In other words, with the discharge arm set back tight against the tier shaft lock, you should be able to pull the dog face away from the stop arm at least ⅛ inch. If you set the stop arm or tier shaft so that the faces are too tight together, other troubles may result when the binder assumes normal speed.

Do not adjust stop arm or tier shaft lock to overcome difficulties caused by the dog's actually being out of time as described in Trouble 11. Likewise, do not try to overcome this tapping trouble by throwing the dog out of time.

Trouble 11. Pounding. Dog Driver Pounds Dog.

Usually accompanied by the discharge arms shaking, vibrating, or seeming to chatter. If dog driver simply taps or clicks the dog, see Trouble 10, page 15. Pounding is serious. There are several causes. Refer to illustrations on pages 6, 7, and 8.

Cause A. Dog slightly out of time—fast. Gear which carries dog has been advanced a few teeth. Discharge arms then shake before they reach home, that is, before they have advanced far enough to be locked up by tier shaft lock. Retime dog as described under Trouble 5. Do not attempt to overcome dog-out-of-time by adjusting stop arm or tier shaft lock. For further description, see explanation under Cause B, following.

Cause B. Dog slightly out of time—slow. Gear which carries dog has been retarded a few teeth. Discharge arms then shake in position higher than home, that is, they vibrate after the tier shaft lock has dropped into place. Retime dog as described under Trouble 5. Do not attempt to overcome dog-out-of-time by adjusting tier shaft lock or stop arm.

Explanation of Causes A and B. Under the explanations of Troubles 5 and 10 preceding, read carefully about the power train between the dog, stop arm, discharge arms, and tier shaft lock. If some part of this power train is removed to make repairs or to supply new parts, and in replacing these parts proper attention is not given to the timing relationships, the dog is almost sure to be out of time with the stop arm. For instance, suppose one removes the bevel gear which on most heads carriés the dog; suppose he removes the tier shaft cam wheel; or, when the knotter head is removed, suppose the tier shaft slips toward the front of the binder and the tier shaft cam wheel slips out of mesh with its driver. If, in reas-

sembling, these parts are not put together in proper relation, the dog will be out of time. If the dog is badly out of time, Trouble 5 above may occur.

If the dog is only a few teeth fast, or slightly fast, it will be thrown out by the stop arm before the tier shaft lock has dropped into place; then the dog spring will back up the whole power train (see description under Trouble 10), the discharge arm will drop back from home, and the dog will back away from the stop arm. Almost immediately, however, the next lug on the dog driver will hit the dog and the process is repeated quickly again and again. Hence a severe pounding is heard, and at the same time the discharge arms may shake or vibrate seriously "below home" or just before they reach their normal position of rest.

If the dog is a few teeth slow, or slightly slow, it will not be thrown out by the stop arm until the discharge arms have passed their normal position of rest. These arms then will drop back until stopped by the tier shaft lock, and in so doing they back the dog away from the stop arm. Almost immediately, however, the next lug on the dog driver hits the dog and the process is repeated quickly again and again. Hence a severe pounding is heard, and at the same time the discharge arms may shake or vibrate seriously "above home" or just after they reach their normal position of rest.

Do not adjust stop arm or tier shaft lock in an attempt to overcome the evils of non-timing. Likewise do not throw the dog out of time in an attempt to overcome the poor stop arm or tier shaft lock adjustments described below. If tapping occurs after timing, adjust further as described under Trouble 10.

Cause C. Tier shaft lock is slightly advanced from normal position, or stop arm is too long. Discharge arms then shake or chatter before tier shaft lock drops into locking position. In modern heads either the tier shaft lock or the stop arm is adjustable. Set tier shaft lock back slightly, or shorten stop arm. Be sure to maintain proper clearance between striking faces of stop arm and dog as described under Trouble 5. For further description, see explanation under Cause D.

Cause D. Tier shaft lock is slightly retarded from normal position, or stop arm is too short. Discharge arms then shake after tier shaft lock drops into locking position. In modern heads either the tier shaft lock or the stop arm is adjustable. Advance tier shaft lock slightly, or lengthen stop arm. Be sure to leave proper clearance between striking faces of stop arm and dog as described under Trouble 5. If the tier shaft lock consists of a flat spring which is so badly worn on the end that it can no longer be advanced far enough, supply new spring.

Explanation of Causes C and D. Under the explanations of Troubles 5 and 10 preceding, read carefully about the power train between the dog, stop arm, discharge arms, and tier shaft lock. If dog is in time, but the stop arm is too long or the tier shaft lock is advanced too much, the dog

will be thrown out before the tier shaft lock has dropped into place. Then the weight of the discharge arms, together with the backing action of the dog spring, will back up the whole power train (see description under Trouble 10), the discharge arms will drop back from home, and the dog will back away from the stop arm. Almost immediately, however, the next lug on the dog driver will hit the dog and the process is repeated quickly again and again. Hence a severe pounding results and the discharge arms will shake below home as in Cause A on page 16.

If the dog is in time, but the stop arm is too short or the tier shaft lock is retarded too far, the dog will not be thrown out until the discharge arms have passed their normal position of rest. Then the arms will drop back until stopped by the tier shaft lock, and in so doing they back the dog away from the stop arm. Then the pounding occurs just as described in the preceding paragraph, but now the discharge arms shake, as in Cause B, after the tier shaft lock has dropped into place.

If tapping occurs after stop arm or tier shaft has been adjusted, adjust further as described under Trouble 10. Be sure to leave proper clearance between stop arm and dog as described under Trouble 5 preceding.

Cause E. It is obvious that if the tier shaft lock is lost, loose, broken, or its spring weak, the effect will be the same as in Causes A or C preceding.

Trouble 12. Discharge Arms Shake, Vibrate, or Seem to Chatter in Position Higher Than "Home."

Same as Trouble 11. See Trouble 11, Causes B and D.

Trouble 13. Discharge Arms Shake, Vibrate, or Seem to Chatter Before They Reach "Home."

Same as Trouble 11. See Trouble 11, Causes A, C, and E.

Trouble 14. Binder Head is Quiet When Bundle Starts to Form. As Bundle Forms, Tapping (Trouble 10) Begins to Develop. Just Before the Bundle is Ready to be Cast, Pounding (Trouble 11) is Heard and the Discharge Arms Begin to Shake.

This happens when the striking faces between dog and stop arm have become worn bevel shaped as described in Trouble 9. Remedy as in Trouble 9.

Explanation. When the bundle begins to form the stop arm is completely down so that it holds the dog away from the dog driver. As the bundle fills, the stop arm rises a little; this lets the dog advance slightly, because the striking faces between stop arm and dog have become worn bevel shaped. In this slightly advanced position the dog driver taps the dogs. Just before the bundle is full, the stop arm has raised sufficiently to let the dog far enough forward to be pounded by the dog driver. As soon as the pounding starts the discharge arms may shake, inasmuch as they

reflect the effect of the pounding through the power train described under Trouble 10.

This trouble often exists concurrently with Trouble 9. Obviously, it is likely to occur more frequently when the trip spring is set for a loose bundle.

Trouble 15. An Occasional Excessively Large Bundle.

If this occurs when cutting wheat on ground where corn was shocked, and if the trouble is more frequent when the platform is cutting in the row where corn shocks previously stood, the trouble probably comes from the extremely large butts formed by the ragweeds or other bushy weeds which have grown up in the shock row. As these spots in the field are cut, shift the binder head forward to bind the bundle near the butts, or raise the platform to cut higher.

If this trouble occurs any time under any condition of grain, see Trouble 16.

Trouble 16. Machine "Chokes Down" Because Head "Fails to Trip."

Choking down, in this instance, means that the deck and elevators become clogged with grain because the binder head fails to function at the proper time. Do not confuse the trouble with Trouble 17. If this occurs with a 10-foot binder, because the head is having difficulty in handling the grain cut by such a wide swath, cut a narrower strip through the spots of heavy straw growth.

Cause A. Dog spring weak, lost or broken. See Trouble 3.

Cause B. Striking faces between dog and dog driver badly worn or battered. See Trouble 4.

Cause C. On McCormick and Deere heads (see Figs. 1, 3, and 4), hexagonal nut near top of compressor link does not let the compressor link expand sufficiently to raise stop arm. On Deering head, nut at bottom of spring B will not let compressor link expand sufficiently to raise stop arm. If someone has tinkered with one of these nuts, examine a new head of the same kind and make to determine just where the nut should be set; then place the nut in proper position. These nuts should not be tampered with. If Causes D, E, and F (following) are operative, follow directions given rather than try to overcome the difficulty by molesting the nuts just described.

Cause D. Excessive wear in striking faces between the tail of the stop arm and the compressor link, in the Deering (Fig. 2). Excessive wear between the tail of the stop arm and casting at bottom of compressor link, in the Deere (see Figs. 3 and 4). Excessive wear in the connection between the stop arm and compressor link, in the

McCormick (see Fig. 1). Supply new parts. For further description see Explanation under Cause E.

Cause E. On Deering and Deere heads, excessive wear in stop arm bearing around needle shaft. Supply new parts.

Explanation. The worn condition referred to in Causes D and E prevents the stop arm from raising high enough to release the dog. The wear in the stop arm bearing referred to in Cause E is especially peculiar in that it enables the stop arm to move slightly toward the dog before it is raised, the stop arm's vertical path is checked, and the stop arm tends to bind on the needle shaft. Any binding effect at this point must be overcome by the pressure of the straw against the compressor arm; hence such binding has the same effect as tightening the trip spring.

Do not molest the nuts referred to under Cause C simply to make up for the worn conditions described in Causes D and E. Supply new parts.

Cause F. Stop arm shank bent downward at a point between the stop arm face and the stop arm bearing. Bend back into shape.

Trouble 17. Machine "Chokes Down" When Needle Advances.

When the needle advances, and the discharge arms revolve almost a half turn, the bull wheel slides and the whole machine seems to "choke down." The needle, in attempting to compress the bundle, meets with greater resistance than can be overcome by the force which drives the needle. Adjust the head to tie a smaller, looser bundle, as described under Troubles 1 and 2. Loosen grain checks (see illustrations on pages 6, 7, and 8). On McCormick, Deere, and Osborne heads loosen compressor spring. Do not molest spring B on Deering head, Fig. 2, page 6. It is assumed, of course, that this trouble has not been caused by shortening the needle pitman. For proper length of needle pitman, see under Band I, page 42. For further information about compressor springs see explanation following.

If this trouble occurs with a 10-foot binder, because the binder head is having difficulty to handle such a wide swath, cut narrower through the spots of heavy straw growth. Do not confuse this trouble with Troubles 3, 15, and 16.

Explanation. When the needle compresses the bundle against the compressor arm, rather severe strains are set up within these parts and within their shafts and supports. Some binder heads carry a spring, known as the *compressor spring*, to act as a cushion between parts at the moment of severest strain. Such springs are shown in the illustrations on pages 6, 7, and 8. If an old binder head carries a compressor spring, the spring can be located by finding the device which allows the compressor arm itself,

or the compressor shaft, to give a little as the needle is completing its compressing function.

Compressor springs are not trip springs and should not be confused with such. The trip spring functions when the head is tripped. The compressor spring does not function until the needle is just finishing its upstroke. Referring to the illustrations on pages 6, 7, and 8, do not mistake trip springs for compressor springs.

Compressor springs are properly set at the factory and ordinarily they should not be tampered with. If a compressor spring has been molested, and you wish to get it back to normal set, adjust it to medium tension. Experts know, of course, that the compressor spring can be used to affect tightness of bundle to limited extent. But the average operator can secure as much variation in size and tightness of bundle as he needs by the adjustments given under Troubles 1 and 2, and he will do well to leave the compressor spring strictly alone unless he is forced to loosen it a little to overcome choking down.

Needle pitman being too short will cause the binder head to slide the bull wheel; but under this Trouble 17 it is assumed that the needle pitman is of proper length as described under Band I, page 42.

Trouble 18. Dog Out of Time, or Dog Driver Pounds Dog, After Tier Shaft Cam Wheel Has Been Removed and Replaced, Although the Dog Itself Has Not Been Touched.

Explanation. If the tier shaft cam wheel (one is illustrated in Fig. 3) is removed when the dog assembly is left intact and untouched, the counter shaft between the tier shaft cam wheel and dog bevel gear will "back-up" due to the action of the dog spring. If the operator then replaces the tier shaft cam wheel without advancing the dog to its normal position of rest, the dog will be out of time—one or two teeth slow. In other words, when an old or a new tier shaft cam wheel is placed on the tier shaft, it must be meshed, with the pinion which drives it, in such way as to maintain the proper timing of the dog, provided the dog assembly is intact.

If both the tier shaft cam wheel and the dog are removed, replace the tier shaft cam wheel first and pay no attention to which teeth in the driving pinion mesh with those in the cam wheel; then time the dog, when it is replaced, as suggested in Trouble 8.

But if the tier shaft cam wheel is replaced when the dog assembly is already in place, then the proper timing of the dog must be established between the tier shaft cam wheel and its driving pinion.

Knotter Head and Tying Troubles

(The knotter head is the assembly which receives the twine from the needle and ties the knot. It is located partly between and just under the discharge arms. Common knotter heads are shown on Pages 29, 30, and 31)

ALL knotter head parts have a definite action and function; each works in definite relation and time with every other part. This makes possible a systematic method of determining the causes and remedies of knotter head and tying troubles, just as the definite relationships in a gasoline engine make possible the tracing of ignition trouble. In binder tying troubles, the place where the failing band is found, and the appearance of the band, are the keys to a quick solution of the difficulty.

Use Good Twine. Use twine which is not only strong and clean, but also of even thickness. If you use poor twine which varies materially in thickness, you cannot expect the head to tie consistently and you cannot trace the troubles systematically—probably no trouble exists in the head itself.

If the binder fails to tie occasionally do not think necessarily that tying trouble exists. All binders miss a bundle occasionally. If you are using a new machine, see Warning About New Heads on page 3. If you are using an old binder do not be perturbed about tying troubles until the machine misses frequently enough to assure you that trouble really exists. Then, after reading the warnings on pages 22 to 24, proceed as directed on page 24, "How to Proceed After You are Sure Tying Trouble Exists."

Warning About Twine Tension. As the twine leaves the twine ball in the twine can and extends toward the needle, it passes through a device known as the twine tension. The duty of the twine tension is simply to keep slack from forming in the twine line, to keep the twine line straight between eyes. The twine tension on the common binders is located as follows:

On McCormicks: A roller tension under the grain deck toward the back of the machine.

On Deerings: A sliding tension on the twine can.

On Deeres: A non-adjustable ball on top of twine can, and an adjustable roller tension either under the deck toward the back, or under deck close to packers.

On Osbornes: A roller tension "flopper" on twine can, or a roller tension under deck.

On Massey-Harris: A sliding tension on twine can, and a non-adjustable "flopper" on binder head near tier shaft drive chain.

Keep the twine tension just tight enough to prevent slack from forming at any point between the twine tension and the twine disk in the knotter head; yet loose enough to permit twine to pass *freely* through the twine tension. *Do not throw the twine tension out of normal set in an attempt to regulate tightness of bundles.* If you do, sooner or later tying troubles are sure to appear; this may lead you to making knotter head adjustments when no trouble exists in the knotter head itself.

Warning About Threading. Be sure that the machine is threaded properly according to the directions that come with the machine. The point where the twine first comes onto the needle is especially important. If the line of twine is not correct, if you miss a twine eye, trouble may follow for which knotter is not to blame.

Warning About Dull Knife. The results of a dull, broken, or nicked twine knife are so inconsistent and so varied between different makes of binder heads that they cannot be included easily in the trouble band work which follows. Hence, the chance of a dull knife causing trouble should be eliminated at the start. See that the knife is in proper position; if it is badly nicked, supply a new one; if it is dull, sharpen with good mill file or carborundum stone, being careful to maintain the natural bevel of the knife and using care not to scratch the bills, disk, or stripper.

Warning About Rusty Parts. A rusty set of twine bills, a rusty twine disk, or a rusty needle point is almost sure to cause some tying trouble until these parts become polished to nearly their normal operating condition. Do not make knotter head adjustments in an attempt to overcome troubles caused by rust. First, take steps to remove rust: kerosene may aid materially; moist, fine soil rubbed on for a few minutes with the fingers is a good method. Then keep using the machine patiently until the parts have become cleaned. If you use any instrument to scrape off rust, be very careful not to scratch the parts mentioned. When you store the binder for the winter, slap a liberal supply of good grease over the knotter head parts and on the point of the needle.

Warning About Set of Knotter Head Frame in Respect to Knotter Head Cam Wheel. The tier shaft is the shaft which carries the discharge arms. Close to the discharge arms the tier shaft carries also a knotter head cam wheel which drives the knotter head parts. Notice, too, that the tier shaft passes through the knotter head

frame. The knotter head frame must be held on the tier shaft in such position that the flat sides of the knotter head pinions just barely touch the corresponding tracks on the knotter head cam wheel. If the knotter head assembly is removed and replaced, or if a new knotter head or a new knotter head cam wheel is put onto the machine, great care must be taken to secure the proper set of the knotter head in respect to the cam wheel which drives it. If they are set too close, excessive wear, binding, and grinding of pinions may result. If set too far apart, the twine bills and the twine disk may not be held in proper position; the pinion faces will wear on the corners, and the pinions may bind and tend to jump teeth. The proper relationship *must* be maintained to insure proper knotter head operation. Nearly all binder heads carry an adjustment to maintain this relationship. Sometimes it is a pair of washers the combined thickness of which varies as one washer is turned in respect to the other. Often the adjustment is a large six-sided nut which can be turned slightly on the tier shaft to force knotter head frame near knotter head cam wheel.

How to Proceed after You Are Sure Tying Trouble Exists. Clean all straw out of the head and off the deck. Place good twine in twine box. See that the binder is properly threaded. Now start the machine, watching carefully for the first missed bundle. As soon as the first missed or untied bundle is cast, stop *immediately*. Find the failing band; it may be on the knotter bills; it may be with the unbound bundle on the bundle carrier. Examine the band carefully. Remembering where the band was found, and remembering its characteristics, find that band illustrated in the List of Trouble Bands beginning on page 32, where common causes and remedies are also suggested.

If from the driver's seat you do not see the bundles failing, but the shockers tell you the bands break, bundles come loose, or the bands have tails on them, secure one of these failing bands and proceed to analyze the trouble through use of List of Trouble Bands.

When tracing knotter head troubles by the following system, remember that the trouble bands are rather closely related. If too great an adjustment is made, especially when compound troubles exist, an adjustment to remedy one band may lead quickly to another trouble band. If so, proceed to analyze and correct the new band. This indicates marked progress; you are "on the right track"; use a little patience, and by the process of elimination you will soon reach the solution. By no other means can you trace tying troubles intelligently and systematically. Read again Warning About Adjustments, page 3.

If you do not know exactly how the knot is formed and tied, if you are not thoroughly familiar with the function of each knotter head part, or if your particular make of knotter head is not illustrated herein, read description of the tying process below, also read the explanation under the trouble band in which you are interested. Then find in your knotter head the various parts described, so that you will know exactly what parts to adjust.

All makes of binder and knotter heads are essentially the same in principles of operation; they all contain practically the same essential parts. The parts may vary in appearance and location; but their duties are practically identical. Hence, if one understands the principles of operation and function of parts of any one make of head he should feel perfectly at home with any other make if he is given a moment to locate the principal parts.

Description of the Tying Process

The apparent complexity and mystery of the knotter head and the tying process quickly disappear if one will take a moment to get clearly in mind just how the knot is tied. Then he will be impressed with the simplicity of the operation and the ease with which knotter head troubles can be traced intelligently. The tying process is divided into five steps, each described and illustrated on the following pages. Inasmuch as all common makes of knotter heads are essentially the same, with the same parts having the same functions, it does not matter which make of head is shown to illustrate the principles.

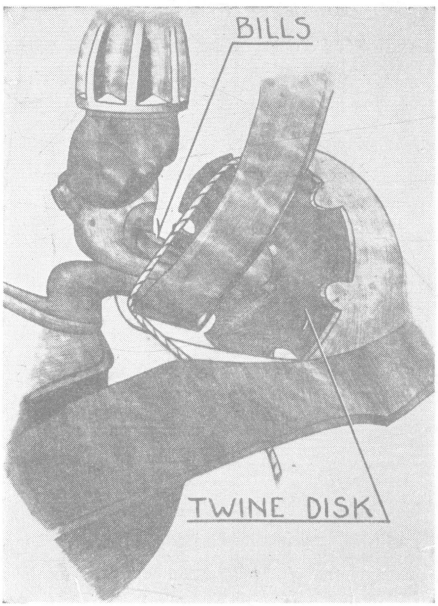


Fig. 8. Step 1 in the Tying Process. While the bundle is forming, the disk end of the band is held by the twine disk. The twine extends from the disk, across the bills, then down under the deck to the needle.

Step 1. Fig. 8 shows the inside of a typical knotter head while the bundle is forming on the deck below. Notice that one end of the twine is held by the *twine disk;* this end is known as the disk end of the band. The twine extends from the

disk backward across the *twine bills*, through the stripper arm, then down through the breast plate and under the bundle to the eye of the needle, which cannot be seen in the illustration. By referring to the illustrations on pages 29, 30, and 31, it will be noticed that a *disk spring* works on the disk; it can be adjusted to make the disk hold the twine either more or less securely.

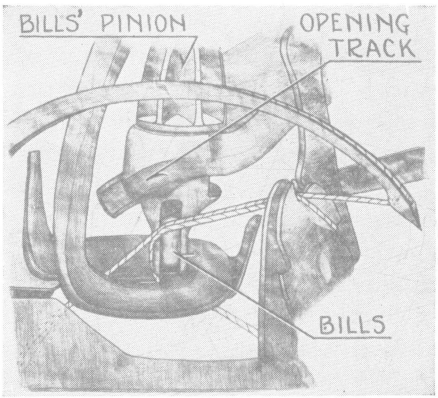


Fig. 9. Step 2 in the Tying Process. The needle brings up the needle end of the band, lays it across the bills and into the disk. The disk turns a little to catch the needle end and to hold the needle end with the disk end of the band.

Step 2. Fig. 9 shows the next step. The bundle being ready to be tied, the binder head has been tripped and the needle pitman has brought up the needle. The needle, carrying the needle end of the band, places the needle end of the band in the same notch in the disk which holds the disk end of the band. Through the disk pinions and shaft (not shown in Fig. 9 but shown in the illustrations on pages 29, 30, and 31), the disk now turns just enough to catch the needle end of the band. Note carefully that the two ends of the band now extend from the disk across the bills, through the stripper arm, and down around the bundle lying below the breast plate.

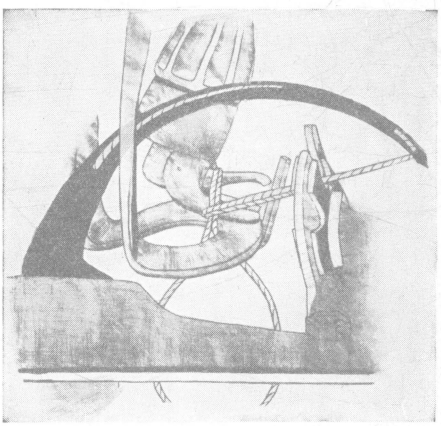


Fig. 10. Step 3 in the Tying Process. The bills revolve, open—and are about to close down on the two ends of the band held by the disk.

Step 3. With the disk holding the two ends of the band and the needle remaining up as shown in Fig. 9, it is now the twine bills' time to function. Being driven by their pinion, which can be seen in the illustrations (Figs. 8 to 12), the bills turn toward the left, and in doing so form around themselves a loop in the twine. When about three-quarters way around they open, as shown in Fig. 10, the upper

bill being forced up by the cam roller on the back of the upper bill. This cam roller can best be seen in Fig. 12, and the track on which it rolls to open the bills can be seen in Fig. 9. As the bills continue their revolutions they take into their grasp the two ends of the band, then close down tightly on the ends as shown in Fig. 11. The upper bill closes because its cam roller has now hit the closing track which can readily be seen in Figs. 11 and 12, also on pages 29, 30, and 31. Notice that a spring works on the closing track; this is the *bills' spring* which regulates the holding tendency of the bills.

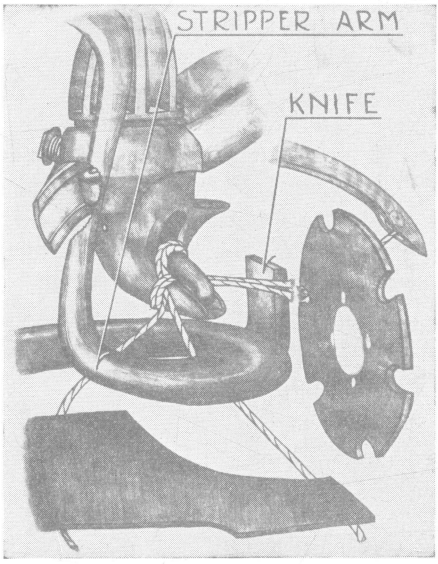


Fig. 11. Step 4 in the Tying Process. The knife cuts the ends of the band free from the disk just before the loop is stripped from the bills.

Step 4. Fig. 11 shows the start of Step 4. The bills have completed their revolution and in so doing formed a loop about themselves and grasped the ends of the band. Something, now, must strip the loop off the bills and do so in the direction in which the bills point. Hence, Fig. 11 shows the stripper arm beginning to advance; it carries a knife which cuts the two ends of the band free from the disk. Notice that the needle has not yet receded. The stripper arm is driven by a cam roller rolling on the stripper cam track within the knotter head cam wheel on the tier shaft. The stripper arm cam roller which projects into the knotter head cam wheel can be seen in Figs. 14, 15, and 16. For heads which do not carry movable stripper arms, see last paragraph on next page.

Step 5. As the stripper arm advances, as shown in Fig. 12, it pulls the loop off the bills because the remainder of the band is being held fast by the bundle below the breast plate. As the stripper arm strips the loop off the bills, the bills hold onto the ends of the band, thus pulling these ends through the loop—and the binder knot is tied. Note in Fig. 12 that the needle now recedes; in doing so it lays the twine in the next notch of the disk as can be inferred from Fig. 11. As the needle recedes it leaves the disk end of the next

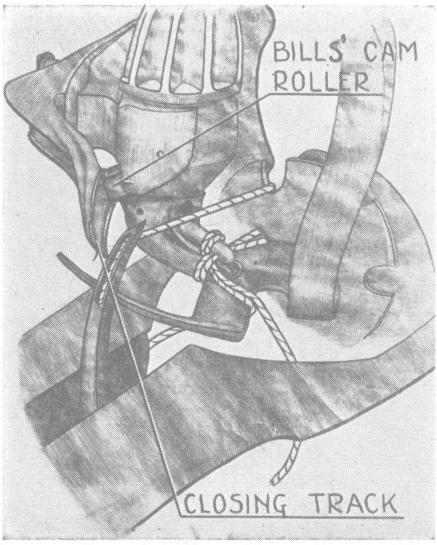


Fig. 12. Step 5 in the Tying Process. The bills hold on to the ends of the band, thus pulling these ends through the loop as the loop is stripped off the bills.

band in the disk; it lays the twine across the bills ready for the next bundle—we are back now to Step 1 in Fig. 8—and the head is ready to repeat the process on the next bundle.

Knotter heads in which the bills rest at right angles to the plane of the needle carry movable stripper arms as indicated in the accompanying illustrations. In some heads, however, like the McCormick and the Massey-Harris, the bills rest pointing slightly outward in such position that they are stripped when the discharge arms cast the bundle. Such heads do not carry movable stripper arms, but they do contain stripping tracks which guide the band in the proper direction for stripping.

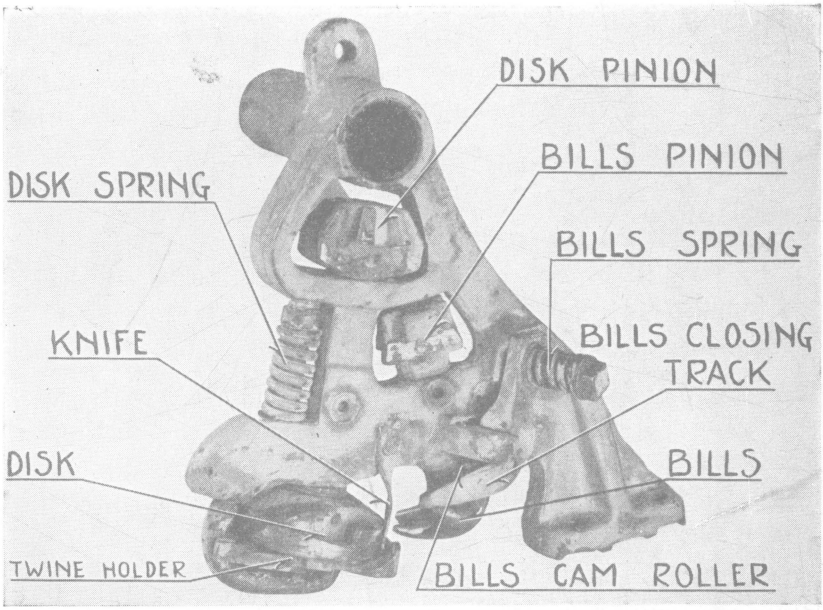


Fig. 13. McCormick Knotter Head. Now Known as I. H. C. Model M.

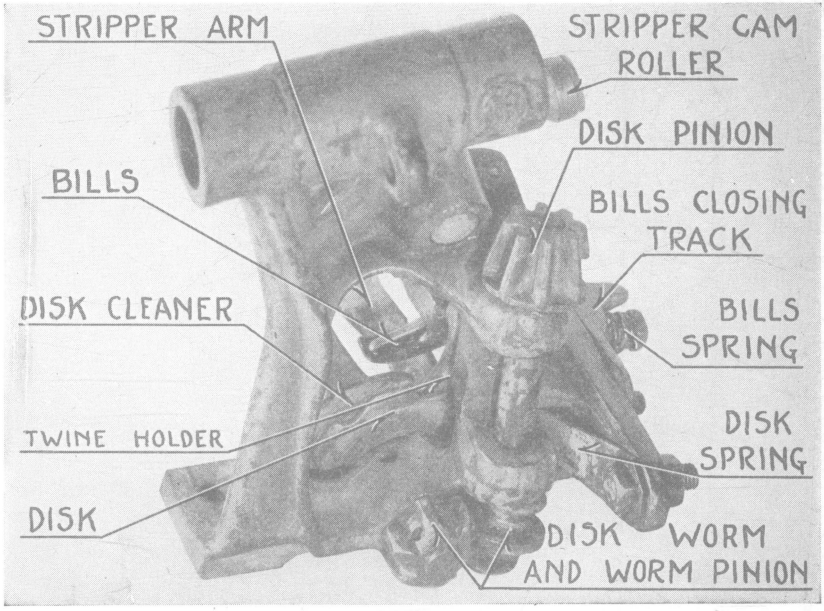


Fig. 14. Deering Knotter Head. Now Known as I. H. C. Model D.

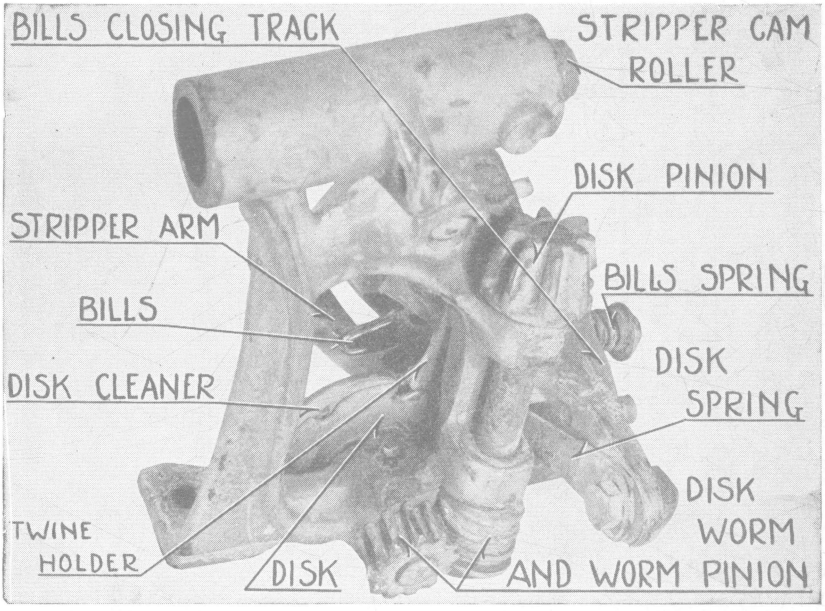


Fig. 15. Deere Knotter Head.

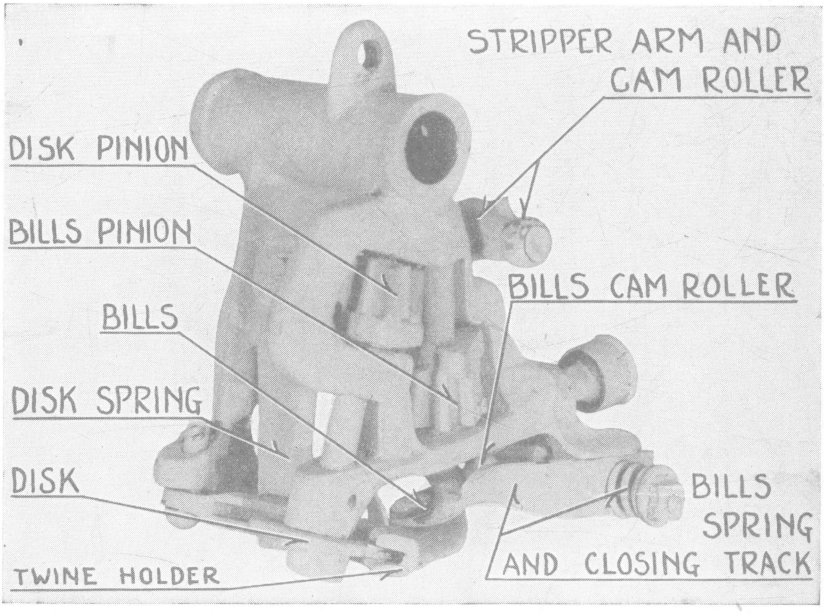


Fig. 16. Case-Osborne Knotter Head. Formerly E-B Osborne, or Osborne.

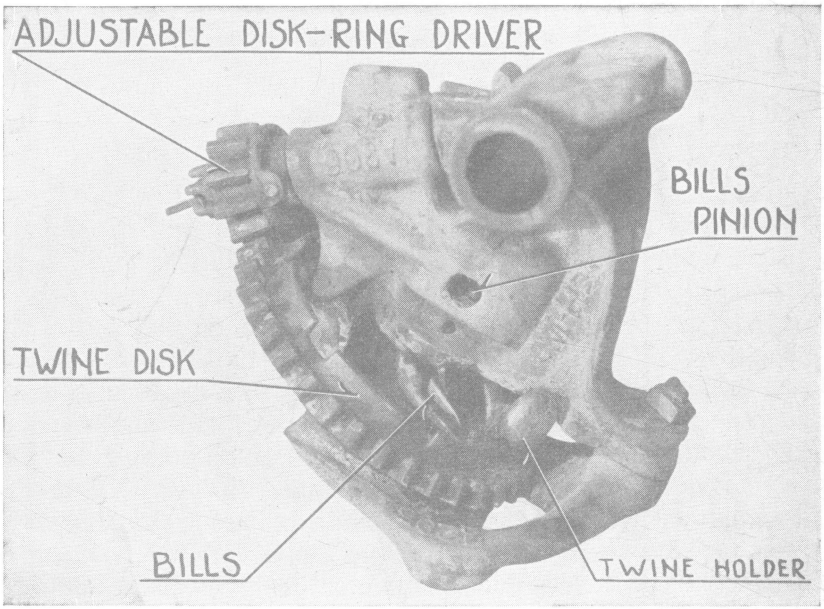


Fig. 17. Massey-Harris Knotter Head. View Showing Bills.

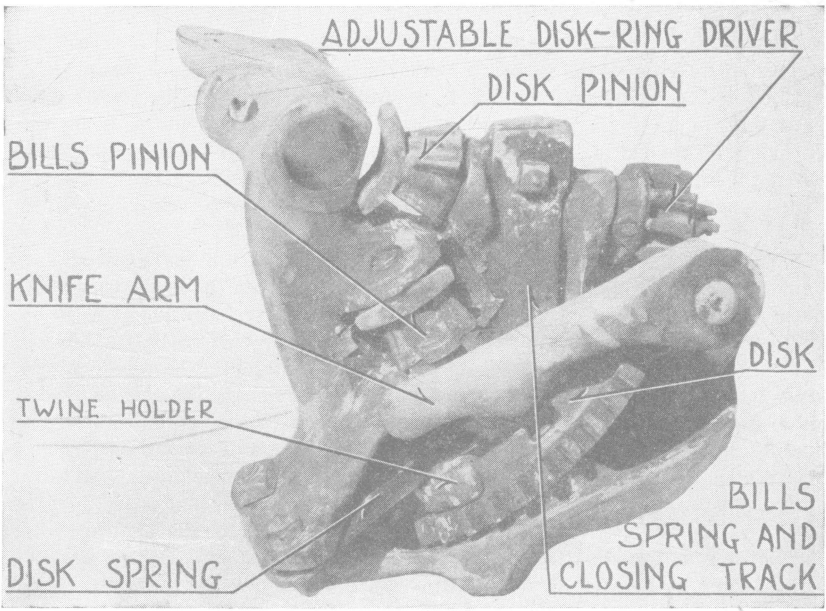
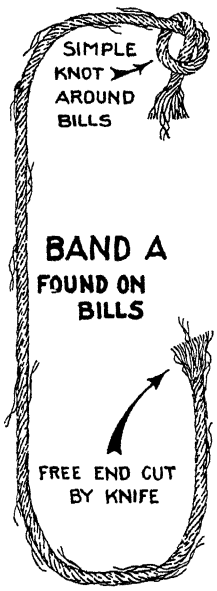


Fig. 18. Massey-Harris Knotter Head. View Showing Springs and Pinions.

List of Simple Trouble Bands Causes and Remedies.

Trouble Band A.



Found on knotter bills, with simple knot tied around bills. Free end shows evidence of having been cut by knife. Disk usually remains threaded. Occurs mostly on those heads in which the twine comes onto the needle near the shank of needle instead of through an eye at the base of the needle.

Common Cause: Twine tension a little too tight and twine disk a little too loose. Loosen twine tension gradually. If the trouble disappears, make no further adjustments. If Band B appears after twine tension has been loosened, tighten disk spring slightly as described under Band B. The result of twine tension being a little too tight and disk a little too loose on those heads in which the twine comes onto the needle through an eye at the base is shown under Trouble F—No Band.

Explanation. In those heads in which the twine comes onto the needle near the shank of the needle, the needle pulls twine from the twine can as soon as it advances for the tying process. Its success in securing twine depends upon the twine tension being loose enough to yield twine, also upon the twine disk being tight enough to hold the disk end of the band. If the disk is a little loose and the twine tension is a little too tight, or even if the disk is perfect and the twine tension is quite tight, then, when the needle advances, it can pull the disk end of the band out of the disk easier than it can pull twine through the twine tension from the twine can.

If the disk end of the band pulls out of the disk when the needle advances, it will be pulled away from the bills and under the bundle. The needle, however, may proceed to place the needle end of the band in the disk; when the bills revolve they catch the needle end of the band only, and when the stripper arm advances it cannot strip the resulting simple knot from the bills because nothing is holding the band to give it the resistance necessary for successful stripping. Hence the bundle is cast unbound, and the failing band is found on the bills. The free end of the band shows evidence of having been cut by the knife, because in this case the entire end pulled out of the disk instead of being broken off at the disk. If the entire end pulled out, the free end of Band A is the end cut when the knife functioned at the preceding bundle.

Always make sure first that the twine tension is set properly as described on page 22. Check up on twine tension before making adjustments in head. Loosening twine tension usually overcomes this difficulty. If twine tension is perfect but disk is still loose, Band B will appear.

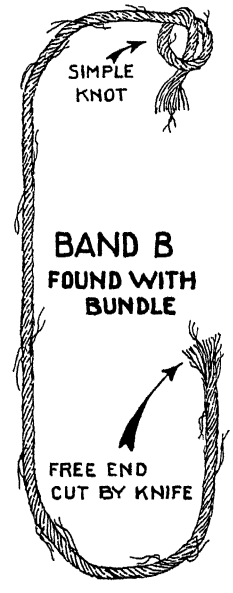
Trouble Band B.

Formed with cast bundle. May not be noticed until shocker picks up bundle. Simple knot in one end of band; other end shows evidence of having been cut off by knife. A slip knot was tied; one end of band pulled out of the simple knot in other end. Disk usually remains threaded. The most common of all trouble bands.

Cause 1. (The most common cause). Twine disk too loose, but twine tension well adjusted. Tighten disk spring slightly—one-quarter turn of the controlling stud bolt. If the trouble is not overcome after three or four attempts to remedy it by tightening disk spring, see less frequent causes, pages 34-35. If Band D or Band E appears after disk spring is tightened, see under those bands.

If you have a McCormick new type head and Band B continues after you have tightened disk quite tight, the trouble may be caused by twine fiber accumulating around the post on the underside of disk; this forces the disk plate away from the disk. If this seems to be the trouble and the disk plate on your knotter head is casting TA821, replace this casting TA821 with a new casting TB821H.

If this Band B appears regularly with every second, fourth, fifth, or sixth bundle (according to the number of notches in the twine disk) look for trouble in one notch of disk.



Explanation. In this trouble the twine tension is set correctly enough to let the needle take twine from the twine can (when the former advances to or recedes from the tying process) without pulling the disk end of the band out of the disk. All parts function properly until the bills begin to revolve. As the bills revolve and pull twine from the disk to form a loop about themselves, the disk end of the band pulls out of the disk entirely because the disk is a little too loose. This end will not drop away from the bills because it is bound onto them by the other end of the band, but the free end is now so high that the bills cannot grasp it as they open. Hence the bills catch the needle end of the band only, and with this end they tie a simple knot around the other end of the band. This results in a perfect slip knot. Inasmuch as the band is around the bundle, the stripper can strip this knot from the bills. Thus the band passes out with the bundle, and when the bundle spreads, or when the shocker handles the bundle, the slip knot pulls out, leaving the band as indicated in the illustration.

When they revolve the bills must secure twine from some place with which to form a loop about themselves. They secure a little of this twine from the bundle; the rest they must secure from the disk. Hence the disk should be loose enough to

allow both ends of the band to back out of the disk a little without breaking, yet tight enough to prevent the disk end of the band from pulling entirely free of the disk.

Cause 2. (Less frequent than Cause 1). Cam roller on back side of upper knotter bill does not turn, hence it has become worn lopsided. Upper bill then does not open wide enough to catch both ends of the band. Supply new set of knotter bills. In extreme cases it may be necessary to supply also a new knotter head frame if the opening track on the frame (see Fig. 9) has become badly worn by the stuck cam roller. For further description, see explanation under Cause 3.

Cause 3. (Less frequent than Cause 1). Excessive wear under knotter bills' pinion may permit bills to rest lower than their normal position. When they revolve the upper bill does not open wide enough to catch both ends of the band. This trouble may be remedied temporarily by placing under the bills' pinion a washer filed down to proper thickness. A new bills' pinion is a better remedy, although in extreme cases it may be necessary to supply both a new bills' pinion and a new knotter head frame.

Explanation. As indicated in Fig. 10 the bills must open wide in order to grasp both ends of the band. If the diameter of the bills' cam roller has been materially decreased, as in Cause 2, or if the bills' pinion does not hold the bills up well against the opening track, as in Cause 3 immediately preceding, the upper bill will not be opened wide. If it does not open wide enough to grasp both ends of the band the upper bill may wedge in between the two ends and grasp the lower end only. With this end the bills tie a simple knot around the other end of the band. Thus a perfect slip knot is tied. This passes out with the bundle, because the stripper can strip the bills inasmuch as the bundle is holding the band.

In old machines Causes 2, 3, and 4 may be operative at the same time; one augments the other. It is assumed in this explanation that the disk is of proper tension, and that the knife and stripper arm are working properly. If several of these devices are failing to function at the same time, the complexity is too involved to warrant further explanation in this brief presentation. If the disk is very tight at the same time that Causes 2 and 3 are operative, Band D may appear.

Cause 4. (Less frequent than Cause 1). Twine disk out of time. Time disk. See explanation immediately following.

Explanation. A twine disk, when in time, has a notch ready under the needle to receive the needle end of the band the instant the needle reaches its advanced position. In nearly all heads this receiving notch is the same notch which holds the disk end of the band, as shown in Fig. 9. If someone has taken the disk and its driving mechanism apart, and reassembled it without heeding the timing relationship, the disk may be so badly out of time that the disk end and the needle end of the band are in different notches. Then the ends are held apart and the bills may catch only the lower end of the band; a slip knot results; if the knife cuts both

ends free, Band B will appear, but if the knife catches the lower end only, Band I may result.

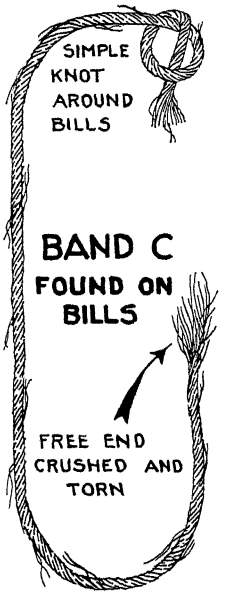
Disks sometimes become "slow" gradually due to wear in their driving parts. If the proper set between knotter head frame and knotter head cam wheel is not maintained (see warning on page 23), the disk may be slow simply because its driving pinion does not complete its revolution. If the disk is slow, the needle end and the disk end of the band may be in the same notch, but the disk may not carry both ends low enough to be caught by the bills. Then, if the upper bill wedges in between the ends and catches only the lower end, a slip knot will result. If the knife cuts both ends free, Band B will appear; but if the knife catches only the lower end, Band I may result.

Retime the disk if it has been assembled wrong. If wear is the cause for the disk being a little slow, speed it up by the timing adjustment if the head carries such. If the disk is plunger driven, the plunger is probably adjustable in length or stroke. If the disk is driven by a gear pinion which is held onto its shaft by a nut instead of a key, perhaps you can set the pinion ahead slightly in respect to its shaft. If no adjustment is furnished to compensate for wear, new driving parts may have to be supplied.

Remember that Causes 2, 3, and 4 may be operative at the same time. Check up also on Causes 2 and 3.

Cause 5. Twine tension very loose, lost or broken. See Warning About Twine Tension, page 22.

Explanation. If the twine tension does not hold the twine back properly, the needle end of the band may not be held taut as it extends from the disk back across the bills (see Fig. 9); this end may be placed in and caught by the disk properly, yet it may loop up from the disk end of the band instead of lying down close to it. Then one of three results commonly occur: (*a*) when the bills revolve the needle end of the band may be caught above the bills and "twine wrapping above the bills" results; (*b*) if the needle end is not caught above the bills, but the upper bill fails to catch the needle end when the bills revolve, then Band B will result if the knife cuts off both ends of the band; (*c*) but if condition (*b*) exists, and the knife cuts off only the disk end of the band, Band I may result.



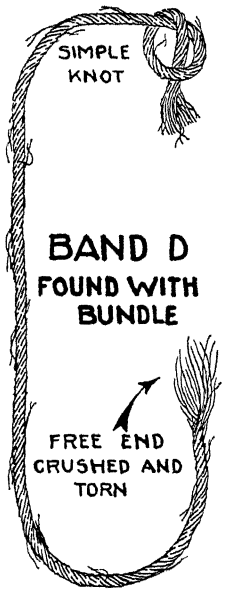
Trouble Band C.

Found on knotter bills with simple knot tied around bills. Free end shows evidence of having been crushed and torn free from the disk instead of having been cut by the knife. Disk usually remains threaded. Occurs occasionally on those heads in which the twine comes onto the needle near the shank of the needle instead of through an eye at the base of the needle.

Common Cause. Twine tension too tight and twine disk too tight. Loose twine tension gradually and loosen disk spring slightly. If Band D appears after twine tension is loosened, see directions under Band D. If Bands A, B, or Trouble F—No Band appears after disk is loosened slightly, see direction under those bands.

For result of twine tension too tight and disk too tight on those heads in which the twine comes onto the needle through an eye at the base of the needle, see Trouble F—No Band.

Explanation. This band is formed in the same manner as Band A except the disk end of the band breaks at the disk, instead of pulling out of the disk, when the needle advances. See Explanation under Band A, keeping in mind that with Band C the disk is so tight that it crushes and weakens the twine where the latter enters the disk; hence the disk end of the band cannot withstand the pull created when the needle attempts to pull twine through a tight twine tension.



Trouble Band D.

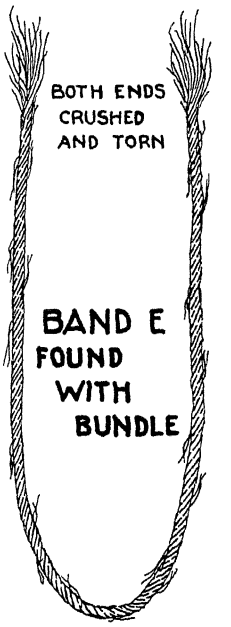
Found with cast bundle. May not be noticed until shocker picks up bundle. Simple knot in one end of band; other end shows evidence of having been crushed and torn. A slip knot was tied; one end of band pulled out of simple knot in other end. Disk usually remains threaded.

Cause 1. Twine disk too tight, but twine tension well adjusted. Loosen disk spring slightly—one quarter turn of controlling stud bolt. If trouble ceases, make no further adjustments. But if, after disk is loosened slightly, Band B persists in appearing, see Causes 2, 3, 4, and 5 under Band B.

Explanation. In this trouble one end of the band breaks at the disk when the bills revolve, because the disk is so tight that it refuses to yield twine properly to the bills. The process of tying the slip knot, then, is the same as described in Explanation under Cause 1 for Band B. With Band B the disk end of the band pulls out of the disk; with Band D, one end breaks off at the disk. See Explanation under Cause 1, Band B, for further description of how slip knot is tied when disk loses one end of band, also why disk must yield twine to bills. If disk is so tight that both ends of band break free from disk when bills revolve, Band E results.

Cause 2. Disk out of time. See explanation in first paragraph in Explanation of Cause 6 for Band I.

Trouble Band E.



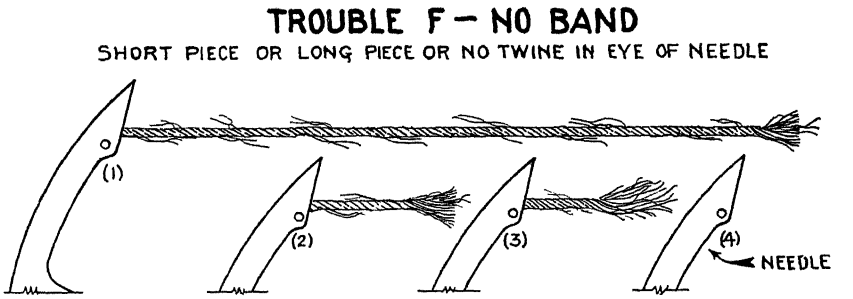
Found with cast bundle. No knot, and both ends of band show evidence of having been crushed and torn. Disk usually remains threaded.

Common Cause: Twine disk very tight, but twine tension may be well adjusted. Loosen disk spring slightly. If Band D appears, loosen disk spring a trifle more. If Band A, B, or C appears see under those bands.

Explanation. As described in Explanation under Cause 1 for Band B, the twine disk must be loose enough to permit the bills to pull both ends of the band back slightly as the bills revolve to form a loop about themselves. In this trouble the disk is so tight that both ends of the band break free from the disk when the bills revolve; these ends slip away from the bills; hence no knot is tied, and the twine passes out of the head with the bundle.

Trouble F—No Band.

Short piece or long piece of twine protruding from the eye of the needle, or the twine may be pulled back so far in the needle that no twine is in the eye, and the disk is not threaded. Occurs mostly on those heads in which the twine comes onto the needle through an eye near the base of the needle, as discussed in Cases 1



and 2. But under extreme conditions it can occur on any binder head as in Cases 3 and 4. Find the end of the twine, then refer to the following:

Case 1. On those heads in which the twine comes onto the needle through an eye at the base of the needle, if the end of the

twine shows evidence of having been cut by the knife, there is indication that the twine tension is too tight and the twine disk may be a little loose. First, loosen twine tension slightly; if the trouble continues, tighten disk slightly. If, after loosening twine tension, Band B appears, see under Band B. If the trouble continues on the new type McCormick head, see special reference to the McCormick disk under Cause 1 for Band B.

Explanation. On heads in which the twine comes onto the needle through an eye at the base of the needle, the needle usually takes twine from the twine can when it recedes from the tying operation. If the twine tension is so tight that the needle cannot secure twine easily from the twine can, the needle may pull the disk end of the band out of the disk. If the disk end is pulled from the disk just as the needle starts back, the end of the twine protruding from the eye of the needle may be too short to permit the needle to thread the disk on its next trip, hence no more bands will appear until the operator rethreads the disk. However, if the disk end of the band does not pull away from the disk until the needle is nearly home, there may be protruding from the needle eye a piece of twine long enough to permit the needle to thread the disk when the next bundle is cast. Then the second bundle may be tied perfectly, and Trouble F—No Band may not appear again for several bundles.

Case 2. On those heads in which the twine comes onto the needle, through an eye near the base of the needle, if the end of the twine shows evidence of having been crushed and torn there is indication that the twine tension is too tight and that the disk is also too tight. Loosen twine tension. If Band D or E then appears, loosen disk slightly as directed in discussion under those bands.

Explanation. Same as under Case 1 above except that the disk end of the band, instead of pulling out of the disk, breaks off at the disk because it is crushed and weakened, the disk being too tight.

Case 3. This Trouble F—No Band may occur on any head if the twine tension is very tight and the disk is perfectly adjusted. Also it may occur on any head if the disk is very loose and twine tension is perfect. This latter condition sometimes exists in new style McCormick heads which carry disk plate TA821. It is caused by twine fiber accumulating around post on underside of the disk, and forcing disk plate away from disk. Replace casting TA821 with a new casting TB821H.

Explanation. Even on those heads in which the twine comes onto the needle near the shank of the needle, Trouble F—No Band may result if the disk end of the band leaves the disk the moment the needle starts up. On such heads, however, a combination twine tension and disk trouble more often results in Bands A and C. A moment's reflection, and reference to the Explanation under Case 1, should make clear how Trouble F—No Band may result on any head from the Causes given in Case 3.

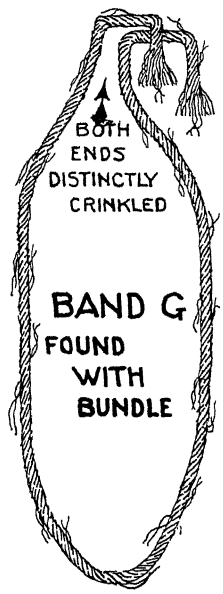
Case 4. On any binder head Trouble F—No Band may occur occasionally if any of the twine eyes are badly grooved; this is especially true if poor, uneven twine is used. Use better twine or supply new eyes, and when tying the tail of one twine ball to the lead of the next, be sure to pull the square knot or the weaver's knot very tight and cut the excess ends off close to the knot.

Explanation. When a binder is run several seasons with the twine tension too tight, the eyes through which the twine passes become badly grooved. In extreme cases the grooves are deep and as wide as the average thickness of the twine. Obviously, if a thick portion of twine, or knot, sticks in one of these grooves, no more twine will pass. Often in this case no twine is found in the eye of the needle.

Trouble Band G.

Found with cast bundle. Both ends of band distinctly crinkled, showing that the knot was formed but not completed properly. Disk usually remains threaded.

Cause 1. Mashed pieces of straw or grain under the upper knotter bill and in the groove of the lower bill. In examining for this cause, do not pry the upper bill open with a screw driver, nail, or knife. Turn the discharge arms over by hand until the bills are open; or with the left thumb press back on the bills' closing track, and with the right thumb raise the upper bill. Clean cut foreign matter; be careful not to scratch bills. For explanation, see under Cause 4.



Cause 2. Bills' spring too loose. Tighten bills' spring slightly—one quarter turn of controlling stud bolt. If the trouble continues, tighten slightly again. If trouble cannot be overcome by tightening bills' spring, see less frequent causes below. If Band H appears after bills' spring is tightened see under Band H. For explanation, see under Cause 4.

Cause 3. Hump on underside and near tip of upper bill is badly worn away. The function of the hump is to help "hook" the ends of the band through the loop. This hump, together with the groove in the lower bill, wears away, especially on machines on which bills' spring has been set too tight for several seasons. The best remedy is a new set of bills; but the trouble can be helped temporarily by

filing away a little metal from the underside of the upper bill and just inside of the old hump. Use a small round file; finish with emery cloth; leave no sharp edges or rough file marks. For further explanation of this cause, see under Cause 4.

Cause 4. Bills' closing track or bills' cam roller badly worn. If closing track becomes badly grooved, or if the effective diameter of the bills' cam roller becomes materially cut down because of wear or lop-sided shape, the closing track or spring may not be able to close upper bill tightly. Supply new closing track and new set of bills.

Explanation. The upper bill must close down on the ends of the band tight enough to hold on to those ends and pull them through the loop as the stripper strips the loop from the bills. If foreign matter gets under the upper bill (Cause 1); if the bills' spring is too loose (Cause 2); if the hump on the upper bill has worn badly (Cause 3), or if the bills' cam roller and closing track has become badly worn (Cause 4), the upper bill may release the ends of the band too soon. The ends may slip out of the bills ahead of the loop; in that case the knot is not completed. Or the ends may not be detained by the bills after they have been "hooked" through the loop; in that case the knot is not tightened up enough to prevent its unfolding when the bundle spreads.

Cause 5. Knife arm bent. Bend back into shape.

Explanation. On some heads in which the knife is carried on a movable stripper arm or knife arm, the arm may become bent in such a way that the knife cuts too close to the loop around the bills. The ends of the band, then, may not be long enough to prevent them from slipping back through the knot when the spreading of the bundle tends to unfold the knot. Usually the knife cuts at such a point that at least an inch of ends protrudes from the knot itself.

Trouble Band H.

Found on bills with regular binder knot formed perfectly around bills, but band is broken somewhere within the loop. Band did not strip from bills so it had to break when the discharge arms forced out the bundle. Unless poor quality twine is being used, this band is not common with heads which do not carry movable stripper arms.

Cause 1. Rusty or rough bills. See Warning About Rusty Parts, page 23. If this band appears when an old binder is first taken to the field, probably rust is the chief cause. Loosening bills' spring slightly may help until bills become polished; but as soon as Band G appears, tighten bills' spring again. If bills are polished and smooth, see less frequent causes 2, 3, 4, and 5. For explanation, see under Cause 2 on next page.

Cause 2. Knotter bills' spring too tight when binder head is set to tie a loose bundle. Loosen bills' spring slightly. If the bills' spring is loosened too much, Band G will appear. If the trouble cannot be overcome by adjusting the bills' spring, set binder head to tie a tighter bundle (see Trouble 2). If loosening bills' spring or tightening bundle brings no relief, seek less frequent causes for Band H below.

Explanation. The stripper arm's success in stripping the loop of twine from the bills just before the bundle is cast depends upon three conditions: (*a*) the bills must be polished and be loose enough to let the loop slip off, yet tight enough to pull the ends of the band through the loop, (*b*) the band around the bundle below the breast-plate must be tight enough to furnish more resistance than the bills when the stripper arm advances to strip the bills, and (*c*) the stripper arm must take its full stroke.

If the bills are rusty or rough, or if the bills are too tight when a small or loose bundle is being produced, the bills may offer more resistance to the stripper than the band around the bundle. Then, when the stripper advances, it pulls twine up from bundle, or raises a very loose bundle up against the breast-plate, instead of stripping the bills. As soon as the discharge arms strike, the bundle must pass out, and if the bills have not been stripped the band must break. Obviously a similar condition will exist if the stripper arm does not take its full stroke (Causes 3 and 4 below), or if the twine tension is so loose that the twine was not held taut between the disk and needle eye while the bundle was forming (Cause 5 below).

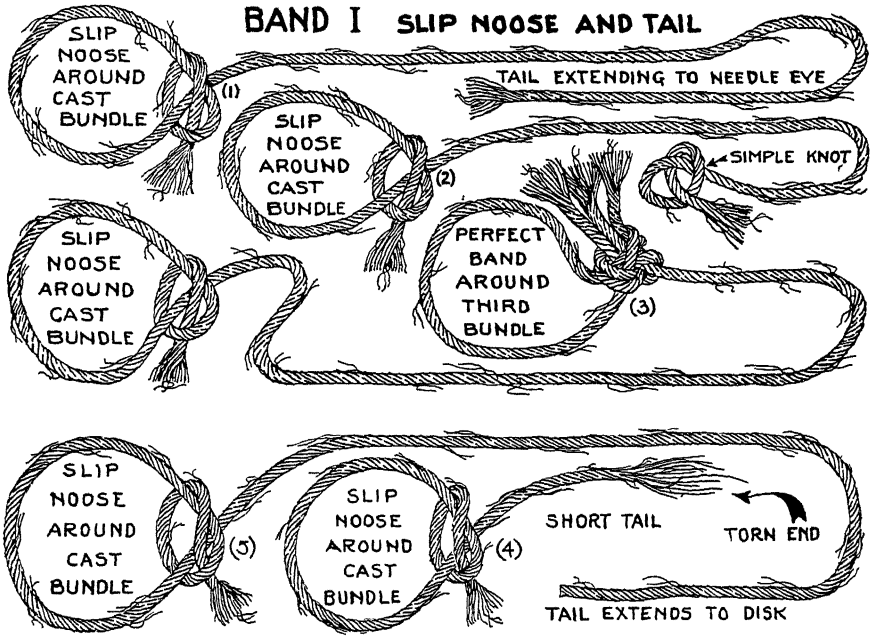
Cause 3. Cam roller on stripper arm, and corresponding cam track in knotter head cam wheel, badly worn. Stripper arm does not advance far enough to accomplish stripping. Supply new stripper arm and new knotter head cam wheel, being careful to observe Warning About Set of Knotter Head Frame in Respect to Knotter Head Cam Wheel, page 23. For explanation, see under Cause 2.

Cause 4. Stripper arm bent in such a way that it does not advance far enough to accomplish stripping. Bend stripper arm back to shape. For explanation, see under Cause 2.

Cause 5. Very loose, weak, lost, or broken twine tension. For explanation, see under Cause 2.

Trouble Band I.

Slip noose tied around cast bundle and twine extends from cast bundle to the eye of the needle, as at (1) in illustration. Or slip noose tied around cast bundle and band has a tail in end of which simple knot is tied, as at (2). Or slip noose tied around one bundle and tail extends to another bundle which may be tied perfectly, as at (3). (In each of above cases, the bundle which follows slip noose will have no band.) Or slip noose tied around bundle and band has a short tail with torn end, as at (4). Or slip noose tied around bundle and tail extends from cast bundle to twine disk, as at (5).



Cause 1. Needle brings up straw or green stuff and forces it through the knotter head. This prevents the disk from catching the needle end of the band. If this band occurs when an old binder is first taken to the field, you may be suspicious of a rusty and, perhaps, dull needle point. See that the needle has a sharp point, that it is smoooth and well polished. It can be sharpened with a fine file, and smoothed and polished with emery cloth. Be sure to leave the faces of the needle smooth, with no scratches or gouges. If damp, green stuff sticks to the needle point after you have treated the point properly, and if much green undertrash, such as plantain or clover, is coming onto the deck, cut higher, especially if Band I seems more frequent through low spots in field.

Explanation. If the needle fails to place the needle end of the band in the disk, that end may be too high to be caught by the bills or to be cut by the knife. The bills, then, with the disk end of the band, tie a simple knot around the needle end; this produces the slip noose around the bundle. Inasmuch as the needle end of the band was not placed in the disk, the needle takes the twine back when it recedes. If the operator stops immediately he will find the twine condition as at (1) in the illustrations of Band I. If the binder is not stopped, the needle may succeed in placing the tail in the disk on its next trip up; hence the disk may become rethreaded automatically, and the third bundle from the slip noose may be tied perfectly. The second bundle from the slip noose, however, went out with no band. When the needle came up for the second bundle and placed the tail in the disk, the bills tied a simple knot in the tail and the knife cut the end free from the disk. If at that time the tail was held taut, and the stripper stripped the simple knot from bills, the shocker will find the first bundle with a twine condition shown at (2) in the illustrations of Band I. But if the stripper failed to strip the bills when it operated for the second bundle, the simple knot on the bills will be tied into the knot of the third bundle. Then two bundles are found tied together as at (3) in the Illustrations of Band I.

Cause 2. Twine tension too loose, weak, broken, or lost. See Warning about Twine Tension, page 22. If tension seems tight enough, seek other causes as suggested below; do not try to overcome Band I by setting twine tension tighter than normal.

Explanation. If the twine tension is too loose, the needle end of the band may bow upward off the bills and out of the disk, instead of being taut across the bills when the needle is up. Then the disk and the bills may fail to catch the needle end, and Band I may result by the process described in Explanation under Cause 1.

Cause 3. Needle may be slow due to wear or to needle pitman having been lengthened. When the needle advances it should pass into the knotter head until the shank of the needle slightly crowds the stripper arm or breast-plate. When at rest, the point of the needle on most heads protrudes a little through the deck, and the "lifters" on the packers raise the grain over the needle point. If someone has tampered with the needle pitman, or if wear in all needle parts has resulted in lost motion, the needle may not be advancing far enough to place the needle end of the band into the disk. If this is the cause, shorten needle pitman a trifle until needle slightly crowds the stripper arm or breast-plate as described above. Beware, however, of a badly worn eye as described under Cause 4. Be very careful not to shorten needle pitman too much. For description of how band is formed, see Explanation under Cause 1.

Cause 4. Needle may advance far enough, as described under Cause 3, yet needle cannot place twine in disk because the eye of needle is badly worn back. Badly worn eyes occur usually because

the binder has been run several seasons with twine tension too tight. If needle carries renewable eye-piece, turn eye-piece around or supply new eye-piece, being very careful to leave the sides of the needle perfectly smooth after riveting. If needle does not contain renewable eye-piece, supply new needle. Obviously Causes 3 and 4 may exist at the same time.

Cause 5. Needle bent. From point to tail the needle conforms very closely to the arc of a circle. Occasionally the point becomes bent up or down, the bending taking place just ahead of the needle shank. If the needle is bent up it may not hold the twine low enough to place the needle end of the band in the disk. There is no practical way to test for the bend other than to sight along the rim to see if the normal curvature has become upset; although sometimes bending can be detected by the fact that the needle point no longer travels in the brightened path which it has worn on the knotter head parts it rubs when it passes into the head. If you are sure that the needle is bent, bend it back into shape by means of a short piece of gas pipe slipped over the point. If a heavy wrench is used be very careful not to twist the needle. In bending a needle back into shape always make the correction at the point at which the first bend occurred. Be careful not to mar the needle within three or four inches of its point, and never bend a needle to make up for a badly worn eye or a slow needle as described in Causes 3 and 4. Explanation under Cause 1 describes how band is formed.

Cause 6. Twine disk out of time. Time disk as described in Explanation under Cause 4 for Band B.

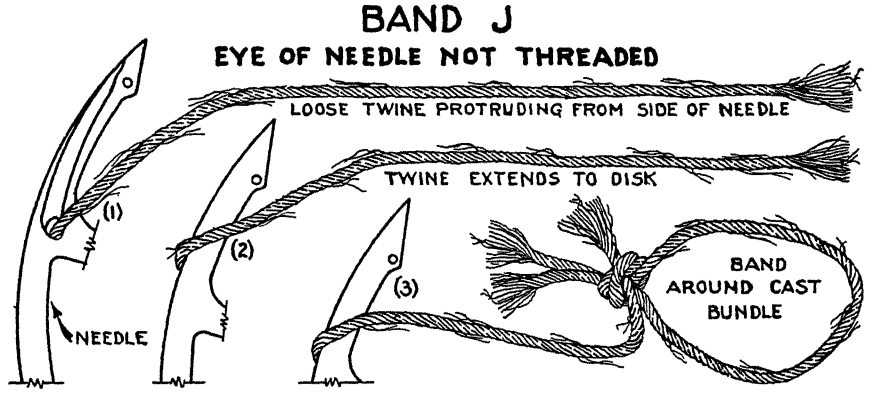
Explanation. If the disk is out of time sufficiently to cause trouble, Band B may result if the knife cuts both ends of the band free from the disk. The process is described in Explanation of Cause 4 under Band B. But if the conditions are such that the knife cuts free only the disk end of the band, and the disk remains threaded, a slip noose will be tied around the bundle and this band will have a short tail, as at (4) in the illustrations of Band I. The tail is due to the fact that the knife did not cut the needle end of the band from the disk; hence that end had to break off at the disk when the discharge arms forced out the bundle. Obviously, this short tail will have a torn end if the disk spring is rather tight. If the tail is very short when a tight bundle is being cast in fluffy grain, the tail may pull out of the slip knot when the bundle spreads; then the band will be identical to Band D except that it will be a little longer than a typical Band D.

If the disk is loose, when the slip noose with short tail is being produced as described in the preceding paragraph, the twine may pull back through the disk instead of breaking off at the disk; then the tail will extend from the cast bundle to the disk, as at (5) in the illustrations of Band I.

Trouble Band J.

Eye of needle not threaded and short piece of twine extends from side of needle as at (1) in illustrations of Band J. Or eye of needle not threaded and twine extends from side of needle to twine disk, as at (2). Or eye of needle not threaded and twine extends from side of needle to cast bundle, as at (3). Occurs mostly with corn binders, but occasionally with grain binders which carry open-face needles.

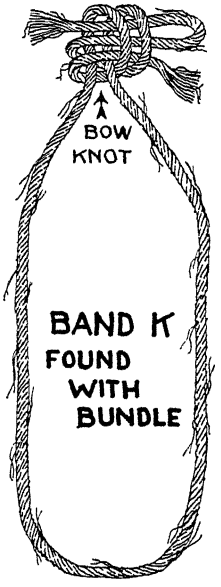
Common Cause: Twine tension very loose, broken, weak, or lost.



Explanation. If the twine tension is very loose, occasionally the twine is thrown out or slips out of the back or side of the needle when the latter reaches its advanced position. This misplaced loop may be caught by the disk; then the disk will hold the loop in addition to the needle end and disk end of the band. When the needle recedes, the twine will extend from the side of the needle to the disk, as at (2), because the disk caught the twine at a point behind the needle eye. If this misplaced loop of twine is caught by the bills as well as by the disk, a perfect band may be tied around the bundle, as at (3), but the misplaced portion will have become tied into the perfect knot. Then the twine may extend from the side of the needle to the cast bundle, and the disk will not be threaded. If the perfect knot is not tight enough to retain the end of the twine coming from the needle, this end will pull out; then the condition shown at (1) will be found.

This condition is more common with corn binders than with grain binders, because, in the former, the needle's position is horizontal and the twine can get out of the back of the needle very easily if the twine tension is loose. Then, too, any foreign material carried into the knotter head by the needle of a corn binder is almost sure to be stiffer than that carried by a grain binder needle, and the stiffer the material the greater the tendency to push the twine into peculiar positions within the knotter head.

If this trouble occurs only very infrequently when the twine tension is set perfectly, the cause may be foreign material coming into the knotter head with the needle.



Band K.

Perfect band, but one end bowed. This is not a trouble band. It is the normal knot tied by some knotters. It is shown here to correct an erroneous idea that this knot requires an excessive amount of twine. Binders which tie this knot simply tie back into the bow the short piece of twine which other binders pass out of the disk as loss.

Explanation. If one will examine a knotter head at the instant the knife is cutting the band ends free from the disk, he will notice that, from the point where the knife cuts for the present band, a short piece of twine runs through the disk to the point where the knife cut the previous band. In most heads this short piece of twine passes out as loss, and is seldom seen because its color is so near that of straw. Double plate disks carry cleaners to force this end out of the disk as the disk revolves. The bow illustrated in Band K is formed in some heads by tying this short end back into the knot.

List of Compound Trouble Bands Causes and Remedies

When two or more troubles exist in a knotter head at the same time, the resulting band may be a combination of two or more of the simple bands just previously presented. In each of these compound bands some characteristics of simple bands can be detected. These furnish the clues. Proceed systematically and intelligently to eliminate one cause at a time. Finally, by this process of elimination, a pure, simple band will result. A few of the more common compound bands follow.

Trouble Band BG.

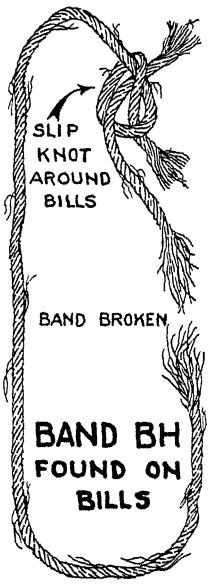
Found with bundle. One end crinkled; other end shows evidence of having been cut by knife. Combination of simple bands B and G.

Common Cause: Disk too loose and bills too loose. See directions under Band B, then those under Band G.

Trouble Band BH.

Found on bills with slip knot, instead of binder knot, tied around bills. Both ends of band show evidence of having been cut by knife. Band broken. Combination of simple bands B and H.

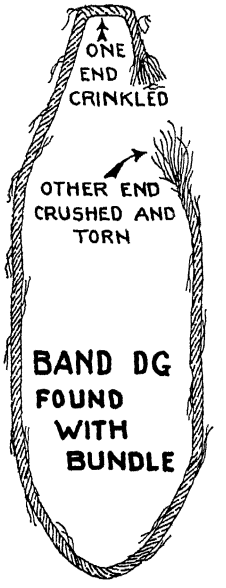
Common Cause: Disk too loose and bills too tight when a small loose bundle is being tied. See directions under Band B, then directions under Band H.

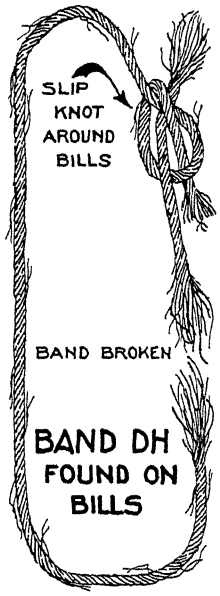


Trouble Band DG.

Found with bundle. One end crinkled, other end crushed and torn. Combination of simple bands D and G.

Common Cause: Disk too tight and bills too loose. See directions under Band D, then directions under Band G.





Trouble Band DH.

Found on bills with slip knot, instead of binder knot, tied around bills. One end on bills is crushed and torn. Band broken. Combination of simple Bands D and H.

Common Cause: Disk too tight and bills too tight when small loose bundle is being tied. See directions under Band D, then those under Band H.

Miscellaneous Tying Troubles

Twine Wrapping Above Bills. The needle end of the band gets caught above the bills' cam roller when the bills revolve. A very loose, weak, lost, or broken twine tension is the most frequent cause; see Warning about Twine Tension, page 22. Under some conditions, however, any one or a combination of any of the following may aggravate the trouble; wear under bills' pinion (see under Cause 3 for Band B); disk out of time (see under Cause 4 for Band B, also under Cause 6 for Band I); needle brings up trash (see under Cause 1 for Band I); needle bent, slow or eye worn back (see under Causes 3, 4, and 5 for Band I).

Several Bands Clinging to Bills. This results when the operator does not stop the machine as soon as a trouble band is produced. See directions under How to Proceed after You Are Sure Tying Trouble Exists, page 24.

Twine Twisting Badly Between Twine Tension and Twine Can. Twine tension too tight, poor twine, or "bells" or rough spots on twine faces of twine tension.

Badly Worn or Grooved Twine Eyes. Caused by having twine tension too tight for several seasons. This condition is dangerous because sooner or later it will lead to Trouble F—No Band.